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(71)Applicant : MATSUSHITA ELECTRIC IND CO LTD

(72)Inventor : KUBOTA HIROSHI

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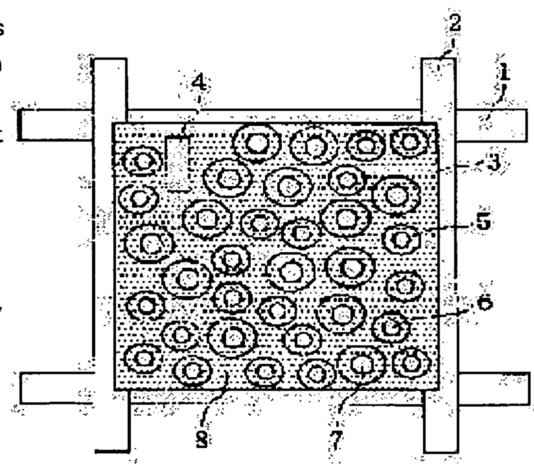
(54) SEMITRANSMITTING LIQUID CRYSTAL DISPLAY DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To improve reflectance and transmittance of semitransmission type liquid crystal panel.

SOLUTION: The semitransmission type liquid crystal display device has a semitransmitting layer having a rugged structure 5 having a reflection layer 3 and transmitting part 6. The transmitting part is formed in the region containing almost flat part of the rugged structure 5. The almost flat part of the rugged structure (namely, a part having a very small inclination angle) does not contribute to the reflectance of the panel but gives mirror reflection, which decreases the display performance. Thereby, by forming a transmitting part in the region including almost flat part in the rugged structure, mirror reflection can be prevented. By forming the transmitting part, the transmittance of light from the back light can be improved.



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CLAIMS

[Claim(s)]

[Claim 1] The transflective LCD characterized by forming said transparency section in the field containing the almost flat part of said concavo-convex structure in the transflective LCD with which the transflective layer which consists of the concavo-convex structure of having the reflective section and the transparency section was formed.

[Claim 2] The transflective LCD according to claim 1 with which the tilt angle which the first half irregularity structure of said flat part has is characterized by 0-degree or more being 2 degrees or less.

[Claim 3] The transflective LCD according to claim 1 with which the tilt angle which said concavo-convex structure of said flat part has is characterized by 0-degree or more being 4 degrees or less.

[Claim 4] The transflective LCD according to claim 1 characterized by said a part of transparency section [at least] not having a transparent electrode.

[Claim 5] The transflective LCD according to claim 1 characterized by said transparency section having a transparent electrode.

[Claim 6] The transflective LCD characterized by forming said transparency section in the field which contains some heights of said concavo-convex structure at least in the transflective LCD with which the transflective layer which consists of the concavo-convex structure of having the reflective section and the transparency section was formed.

[Claim 7] The transflective LCD according to claim 6 with which said transparency section is characterized by forming said top-most vertices in the symmetry as a core further including the top-most vertices of said heights.

[Claim 8] The transflective LCD according to claim 6 with which said transparency section is characterized by being further formed asymmetrically to said crowning including the top-most vertices of said heights.

[Claim 9] The transflective LCD according to claim 6 with which said transparency section is characterized by being prepared in the hemihedry of heights.

[Claim 10] The transflective LCD according to claim 6 characterized by having the unsymmetrical configuration to which the cross section of said heights changes from two or more inclined planes, and preparing said transparency section in the inclined plane where said unsymmetrical configuration is steep.

[Claim 11] The transflective LCD which the cross-section configuration of the heights of said concavo-convex structure is trapezoidal shape, and is characterized by being formed in the field to which said transparency section includes a part of top face of said trapezoid configuration at least in the transflective LCD with which the transflective layer which consists of the concavo-convex structure of having the reflective section and the transparency section was formed.

[Claim 12] The transflective LCD according to claim 11 with which the top-face configuration of said heights is characterized by being a polygon.

[Claim 13] The transflective LCD characterized by forming said transparency section in the field which contains the pars basilaris ossis occipitalis of the crevice of said concavo-convex structure at least in the transflective LCD with which the transflective layer which consists of the concavo-convex

structure of having the reflective section and the transparency section was formed.
[Claim 14] The transflective LCD according to claim 13 which the crevice of said concavo-convex structure has a pars basilaris ossis occipitalis, and is characterized by the pars basilaris ossis occipitalis of a crevice being still flatter.
[Claim 15] The transflective LCD according to claim 13 with which said reflective section is characterized by being asymmetrically formed to the crowning of said heights.
[Claim 16] The transflective LCD according to claim 15 with which said reflective section is characterized by being prepared in the hemihedry of said heights.
[Claim 17] The transflective LCD characterized by being formed in the field where said transparency section includes the top-most vertices of the heights of said concavo-convex structure at least, and the field containing the pars basilaris ossis occipitalis of a crevice in the transflective LCD with which the transflective layer which consists of the concavo-convex structure of having the reflective section and the transparency section was formed.
[Claim 18] The transflective LCD according to claim 17 with which the top-most vertices of said heights and a field with said crevice in which the transparency section was formed are characterized by the almost flat thing.
[Claim 19] The transflective LCD according to claim 8 or 11 characterized by for said transparency section having carried out mutually-independent, and forming it.
[Claim 20] The transflective LCD according to claim 19 with which said transparency section is characterized by having been arranged at random.
[Claim 21] The transflective LCD according to claim 13 or 17 characterized by forming said transparency section from the continuous configuration where the part was connected mutually.
[Claim 22] The transflective LCD according to claim 13 or 17 characterized by forming said reflective section from the continuous configuration where the part was connected mutually.
[Claim 23] The transflective LCD according to claim 13 or 17 characterized by realizing d1<d2 when thickness of the color filter layer on d1 and a crevice is set to d2 for the thickness of the color filter layer on the heights in said concavo-convex structure by forming a color filter layer on said concavo-convex structure.
[Claim 24] The transflective LCD according to claim 23 with which said d2 is characterized by being said twice as many abbreviation for d1 as this.
[Claim 25] The transflective LCD with which electrostatic capacity of the part to which said concavo-convex structure laps with said gate wiring is characterized by decreasing in the transflective LCD with which the transflective layer which consists of the concavo-convex structure where a part laps with gate wiring on a substrate was formed as the distance from the gate writing side of a liquid crystal panel increases.
[Claim 26] The transflective LCD according to claim 25 with which average thickness of the part to which said concavo-convex structure laps with said gate wiring is characterized by increasing as the distance from the gate writing side of a liquid crystal panel increases.
[Claim 27] The transflective LCD according to claim 26 characterized by the rate of surface ratio of heights increasing as the distance from the gate writing side of a liquid crystal panel increases [the rate of surface ratio of the heights of said concavo-convex structure, and a crevice which exists in the part which laps with said gate wiring].
[Claim 28] The transflective LCD with which electrostatic capacity of the part to which said concavo-convex structure laps with said source wiring is characterized by decreasing in the transflective LCD with which the transflective layer which consists of the concavo-convex structure where a part laps with the source wiring on a substrate was formed as the distance from the gate writing side of a liquid crystal panel increases.
[Claim 29] The transflective LCD according to claim 28 with which average thickness of the part to which said concavo-convex structure laps with said source wiring is characterized by increasing as the

distance from the gate writing side of a liquid crystal panel increases.
[Claim 30] The transflective LCD according to claim 29 characterized by the rate of surface ratio of heights increasing as the distance from the gate writing side of a liquid crystal panel increases [the rate of surface ratio of the heights of said concavo-convex structure, and a crevice which exists in the part which laps with said source wiring].
[Claim 31] The transflective LCD according to claim 25 or 28 characterized by said electrostatic capacity changing continuously.
[Claim 32] The transflective LCD characterized by having formed said transparency section in the field which includes the top-most vertices of the heights of said concavo-convex structure at least in the transflective LCD with which the transflective layer which consists of the concavo-convex structure of having the reflective section and the transparency section was formed, and having arranged the micro lens at the heights bottom of said concavo-convex structure.
[Claim 33] The transflective direction liquid crystal display characterized by having the pixel from which the rate of surface ratio of said transparency section differs in the transflective LCD with which the transflective layer which consists of the concavo-convex structure of having the reflective section and the transparency section was formed.
[Claim 34] The transflective LCD according to claim 33 characterized by having the range of the rate of surface ratio where it is not based on the rate of surface ratio of said transparency section, but a panel reflection factor becomes almost fixed.
[Claim 35] The transflective LCD with which said transparency section is characterized by being formed in the field to which the tilt angle which said concavo-convex structure has contains a part 10 degrees or more in the transflective LCD with which the transflective layer which consists of the concavo-convex structure of having the reflective section and the transparency section was formed.
[Claim 36] The transflective LCD with which said transparency section is characterized by being formed in the field to which the tilt angle which said concavo-convex structure has contains a part 10 degrees [or more] and a part 2 degrees or less in the transflective LCD with which the transflective layer which consists of the concavo-convex structure of having the reflective section and the transparency section was formed.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the transflective LCD which can realize a low power by high brightness.
[0002]

[Description of the Prior Art] Although the reflective mold liquid crystal panel attracts attention with the rapid spread of mobile terminals etc., this reflective mold liquid crystal panel has the technical problem that visibility falls extremely, in indoor [dark] and dark Nighttime, while display engine performance sufficient in the environment where outdoor daylight, such as the outdoors, is strong is obtained, in order to display by reflecting outdoor daylight.
[0003] Then, the transflective type liquid crystal panel is proposed as an object which applies a reflective mold liquid crystal panel and can make the outdoors and indoor serve a double purpose. ** which such a transflective type liquid crystal panel prepares the transparency section in a part of toothing-like reflecting layer when a back light configuration is used, and prepares this transparency section in the center of a pixel by the shape of a square -- it was structure [like]. Moreover, it was usually that the above-mentioned concavo-convex structure takes the same structure for every pixel in consideration of the ease of creation conditions (refer to JP,10-319422,A).
[0004]
[Problem(s) to be Solved by the Invention] However, by the technique of preparing the transparency section in the center of a pixel of a reflecting layer greatly like the above, in order that all the parts of the transparency section might not contribute to reflection, when it used as a reflective mold, the technical problem from which sufficient brightness is not obtained occurred. Moreover, although the brightness in the case of a transparency mold is decided by area of the transparency section, when the transparency section is prepared regardless of concavo-convex structure like the above, the technical problem that the reflection factor of reflex time and the permeability at the time of transparency cannot be incompatible also occurs.
[0005] Furthermore, when a color filter layer was the same thickness in the time of transparency, and reflex time, the technical problem that absorption-of-light degrees differed in reflex time and the time of transparency, and hues differed by the time of transparency and reflex time occurred. Since, as for this, light goes and comes back to a color filter layer to reflex time, it is thought that it originates in the thickness of a substantial color filter layer becoming the twice at the time of transparency. When priority was given as a result, for example, a reflection factor, and the color filter with the high permeability for reflection was used, the technical problem that a color became thin also occurred at the time of transparency.
[0006] In addition, since concavo-convex structure was the almost same configuration for every pixel, its capacity configuration of a pixel is also the same in a screen. For this reason, when big screen-ization was attained, it ran in the gate sag resulting from wiring resistance of the gate or the source, and the values of an electrical potential difference differed in the field, and the technical problem that a flicker occurred also had them.
[0007]
[Means for Solving the Problem] In order to solve the above-mentioned technical problem, this invention provided the following means in the transflective LCD of a back light configuration using the transflective reflection layer which concavo-convex structure has.
[0008] Invention according to claim 1 is characterized by forming said transparency section in the field containing the almost flat part of said concavo-convex structure in the transflective LCD with which the transflective layer which consists of the concavo-convex structure of having the reflective section and the transparency section was formed. Since the almost flat part (namely, part with a very small tilt angle) of concavo-convex structure serves as about [not contributing to a panel reflection factor] and specular reflection, it becomes the cause that the display engine performance falls on the contrary. Then, if the transparency section is formed in the field which contains the almost flat part of concavo-convex structure like the above-mentioned configuration, while being able to prevent specular reflection, when the transparency section exists, the light transmittance from a back light can be raised. In addition, the concrete operation effectiveness is explained in the operation effectiveness of following claim 2.
[0009] Invention according to claim 2 is characterized by the tilt angle which the first half irregularity

structure of said flat part has being 0 degrees or more 2 degrees or less in invention according to claim 1. It opts for the reflective engine performance of a transflective layer of having concavo-convex structure, with the tilt angle which the concavo-convex structure of the reflective section has. In order to condense efficiently the light which carries out incidence from a perimeter in the direction of an observer at this time, a tilt angle needs to arrange about 10 degrees by specific distribution from 2 degrees. At this time, the effectiveness that 2 degrees or less and small irregularity become close to specular reflection, and a tilt angle condenses light is small. Moreover, tone reversal occurs by specular reflection and visibility falls extremely. Therefore, the part which has 2 degrees or less and a small tilt angle becomes the cause that do not contribute to a panel reflection factor or the display engine performance falls on the contrary for specular reflection. For this reason, importance had set to form a reflecting layer so that a part with a small tilt angle may not be prepared conventionally. However, on the transflective type display which has a back light, this invention persons found out that improvement in a panel reflection factor could be aimed at while the tilt angle prevented specular reflection by making a small part into the transparency section.

[0010] Then, the concrete operation effectiveness of this invention is explained below in the comparison with a Prior art. The plan of the array substrate in the liquid crystal panel of the transflective LCD of the former [drawing 20] and drawing 21 are the sectional views of the array substrate in the liquid crystal panel of the conventional transflective LCD. When forming the concavo-convex structure 204 by the resist conventionally, and a flat part considered as the configuration which is not generated as much as possible, it had prevented that the tilt angle of a reflecting layer 202 became small. However, however it might form the concavo-convex structure 204, since the top-most vertices of heights became flat, they were the structure where a reflecting layer 202 was formed also in a flat part. Since it was considering as the transflective type by forming greatly the transparency section 205 which does not form a reflecting layer 202 in the center section of the pixel on the other hand, the concavo-convex structure 204 in the transparency section had not contributed to a reflection factor at all.

[0011] Drawing 22 (a) is the explanatory view showing an example of the beam-of-light locus in the reflecting layer of the conventional transflective type liquid crystal panel. Although the reflected light 210 in the ramp of concavo-convex structure contributes to the improvement in brightness, the specular reflection light 211 near heights top-most vertices serves as a cause of tone reversal. Moreover, only the transparent electrode 214 is formed in the ramp of the heights of the transparency section 213, and the transmitted light 215 occurs irrespective of concavo-convex structure. For this reason, the ramp of the heights of the transparency section 213 was structure which does not contribute to a panel reflection factor at all.

[0012] On the other hand, the transflective LCD of this invention is making the flat part in the concavo-convex structure of a reflecting layer into the transparency section, and it aims at improvement in brightness at the time of transparency while it prevents decline in a panel reflection factor. And coexistence of improvement with a reflection factor and permeability can be aimed at by making into the transparency section the part which does not contribute to a panel reflection factor in this way.

[0013] Drawing 22 (b) is the explanatory view showing an example of the beam-of-light locus in the reflecting layer of the transflective type liquid crystal panel of this invention. The transparency section 301 which has a transparent electrode 300 is formed near the top-most vertices of heights. By using this configuration, it generates all over a pixel and the panel reflection factor of the reflected light 302 in the inclined plane which contributes to the reflective engine performance improves. making into the transparency section 301 near the heights top-most vertices which tone reversal had generated with the configuration conventionally on the other hand -- tone reversal -- decreasing -- in addition -- and it becomes possible to also secure the permeability of a back light. Such operation effectiveness is demonstrated because panel permeability is decided by total area of the transparency section.

[0014] It is characterized by the tilt angle in which said concavo-convex structure of said flat part has invention according to claim 3 in invention according to claim 1 being 0 degrees or more 4 degrees or

less. Thus, although the reflection factor in the location near the direction of specular reflection will fall if the tilt angle of 4 degrees or less is defined as a flat field, the panel reflection factor in the check-by-looking direction distant from specular reflection does not change, but the panel whose permeability improved further is obtained.

[0015] Invention according to claim 4 is characterized by said a part of transparency section [at least] not having a transparent electrode in invention according to claim 1. Since the electric-field response of the liquid crystal on the transparency section will be attained by the surrounding reflecting layer and the electric field during opposite even if there is no transparent electrode in the transparency section if the area of said transparency section is small, the same operation effectiveness as the above is demonstrated.

[0016] Invention according to claim 5 is characterized by said transparency section having a transparent electrode in invention according to claim 1. As long as the area of the transparency section is small like the above, there may be no transparent electrode in the transparency section, but if the area of the transparency section is large, it will be based on the reason it is desirable for a transparent electrode to exist in the transparency section.

[0017] Invention according to claim 6 is characterized by forming said transparency section in the field which contains some heights of said concavo-convex structure at least in the transflective LCD with which the transflective layer which consists of the concavo-convex structure of having the reflective section and the transparency section was formed. Since a flat part exists in heights, the transparency section, then the same operation effectiveness as claim 1 are demonstrated for the field containing the part.

[0018] Invention according to claim 7 is characterized by forming said transparency section in the symmetry considering said top-most vertices as a core further including the top-most vertices of said heights in invention according to claim 6. If the transparency section is formed in the field of concavo-convex structure which includes the top-most vertices of heights at least like the above-mentioned configuration, since top-most vertices will serve as a flat part in concavo-convex structure, while preventing decline in a panel reflection factor, improvement in brightness at the time of transparency can be aimed at. That is, coexistence of improvement with a reflection factor and permeability can be aimed at like the top-most vertices of heights by making into the transparency section the part which does not contribute to a panel reflection factor.

[0019] Invention according to claim 8 is characterized by forming said transparency section asymmetrically to said crowning including the top-most vertices of said heights further in invention according to claim 6.

[0020] Invention according to claim 9 is characterized by preparing said transparency section in the hemihedry of heights in invention according to claim 6. If the transparency section is prepared in the hemihedry of heights like the above-mentioned configuration (If the reflecting layer is prepared in the hemihedry of the heights of the opposite side while specifically preparing the transparency section in the hemihedry of the heights located in an observer side mainly) even if outdoor daylight will reflect with an observer's body and it will carry out incidence to a panel from an observer side In order to carry out outgoing radiation of the outdoor daylight to a rear-face side from the transparency section, reflected decreases, consequently its visibility improves.

[0021] In invention according to claim 6, invention according to claim 10 has the unsymmetrical configuration to which the cross section of said heights changes from two or more inclined planes, and is characterized by preparing said transparency section in the inclined plane where said unsymmetrical configuration is steep. When it was the above-mentioned configuration and a steep inclined plane is located in an observer side, the brightness at the time of transparency improves because back light light carries out incidence aslant from the transparency section of heights. Moreover, since the whole surface will serve as a reflecting layer mostly if it sees from a top face, it is effective in a reflection factor improving.

[0022] In the transflective LCD with which the transflective layer which consists of the concavo-convex structure of having the reflective section and the transparency section was formed, the cross-section configuration of the heights of said concavo-convex structure is trapezoidal shape, and invention according to claim 11 is characterized by forming said transparency section in the field which includes a part of top face of said trapezoid configuration at least. Since the top face of a trapezoid configuration is flat, if the transparency section is formed in the field containing the part, the same operation effectiveness as the above will be acquired.
[0023] Invention according to claim 12 is characterized by the top-face configuration of said heights being a polygon in invention according to claim 11. When the flat-surface configuration of heights is made into a polygon, the azimuth of an inclined plane can set it as arbitration, and there is the operation effectiveness of adjusting viewing-angle bearing easily.
[0024] Invention according to claim 13 is characterized by forming said transparency section in the field which contains the pars basilaris ossis occipitalis of the crevice of said concavo-convex structure at least in the transflective LCD with which the transflective layer which consists of the concavo-convex structure of having the reflective section and the transparency section was formed.
[0025] In invention according to claim 13, the crevice of said concavo-convex structure has a pars basilaris ossis occipitalis, and invention according to claim 14 is characterized by the pars basilaris ossis occipitalis of a crevice being still flatter. If the transparency section is formed in the field which contains the flat part of a crevice at least, since it will say that the flat part of a crevice does not contribute to a panel reflection factor, improvement with a panel reflection factor and permeability can be aimed at like the above. Concretely, it explains using drawing 23 . Drawing 23 is the explanatory view showing an example of the beam-of-light locus in the reflecting layer of the transflective type liquid crystal panel of this invention. Improvement with a reflection factor and permeability can be aimed at by making the part 401 between heights 400 almost flat, and making the part 401 concerned into the transparency section.
[0026] Invention according to claim 15 is characterized by forming said reflective section asymmetrically to the crowning of said heights in invention according to claim 13. Invention according to claim 16 is characterized by preparing said reflective section in the hemihedry of said heights in invention according to claim 15.
[0027] If said reflective section is asymmetrically prepared in the crowning of said heights as shown in drawing 24 , outdoor daylight can be effectively condensed in the direction of an observer by the principle same with having mentioned above. If the reflective section is widely prepared in an observer and the opposite side like drawing 24 (a) at this time, the outdoor daylight which carries out incidence to an observer from the opposite side can be condensed effectively. On the other hand, like drawing 24 (b), if the reflective section is widely prepared in an observer side, the light which carries out incidence from behind [which was reflected with an observer's body] outdoor daylight or an observer can be condensed effectively. Moreover, if optimum dose mixture of the pattern of drawing 24 (a) and drawing 24 (b) is carried out, each condensing property can be made to be able to equalize with a mixed ratio of land use, and a condensing property can be adjusted more effectively.
[0028] Invention according to claim 17 is characterized by forming said transparency section in the field which includes the top-most vertices of the heights of said concavo-convex structure at least, and the field containing the pars basilaris ossis occipitalis of a crevice in the transflective LCD with which the transflective layer which consists of the concavo-convex structure of having the reflective section and the transparency section was formed. With such a configuration, a reflection factor and permeability can be raised further.
[0029] In invention according to claim 17, as for invention according to claim 18, the top-most vertices of said heights and a field with said crevice in which the transparency section was formed are characterized by the almost flat thing. Invention according to claim 19 is characterized by for said transparency section having carried out mutually-independent, and forming it in invention according to claim 8 or 11.

[0030] Invention according to claim 20 is characterized by having arranged said transparency section at random in invention according to claim 19. Thus, if arrangement of the transparency section is made random, diffraction does not occur but a panel without coloring or brightness nonuniformity can be obtained.

[0031] Invention according to claim 21 is characterized by forming said transparency section from the continuous configuration where the part was connected mutually in invention according to claim 13 or 19. Invention according to claim 22 is characterized by forming said reflective section from the continuous configuration where the part was connected mutually in invention according to claim 13 or 19. When the reflective section is formed with a conductive ingredient, electrical installation in a contact hole can be easily planned by making the reflective section into the continuous configuration where the part was connected mutually.

[0032] In invention according to claim 13 or 17, a color filter layer is formed on said concavo-convex structure, and invention according to claim 23 is characterized by realizing d1<d2, when thickness of the color filter layer on d1 and a crevice is set to d2 for the thickness of the color filter layer on the heights in said concavo-convex structure.

[0033] Although the light which carries out incidence as outdoor daylight and which is reflected by the reflecting layer penetrates the part of the color filter layer from which thickness is d1, by the time outdoor daylight results in a reflecting layer, while penetrating a color filter layer in this case, after being reflected by the reflecting layer, a color filter layer is penetrated again (that is, outdoor daylight will pass the color filter layer of thickness d1 twice). On the other hand, the transparence light which penetrates and carries out outgoing radiation of the crevice penetrates only once the color filter layer from which thickness is d2 from a back light. Therefore, since the transparence light from a back light will pass the color filter layer of the part to which thickness is large at the time of transparency even if it uses the color filter layer for high reflection of permeability if it is the above-mentioned configuration, even if it is the case of transparence light, sufficient color reproduction nature will be obtained.

[0034] Invention according to claim 24 is characterized by said d2 being said twice as many abbreviation for d1 as this in invention according to claim 23. If it is the above-mentioned configuration, since the transparency distance of the color filter layer in the transparence light and outdoor daylight from a back light will become equal, the almost same color reproduction nature is obtained by the time of transparency, and reflex time.

[0035] In the transflective LCD with which the transflective layer which consists of the concavo-convex structure where a part laps with gate wiring on a substrate was formed, invention according to claim 25 is characterized by decreasing as the distance from the gate writing side of a liquid crystal panel increases [the electrostatic capacity of the part to which said concavo-convex structure laps with said gate wiring]. In invention according to claim 25, invention according to claim 26 is characterized by increasing as the distance from the gate writing side of a liquid crystal panel increases [the average thickness of the part to which said concavo-convex structure laps with said gate wiring].

[0036] In invention according to claim 26, invention according to claim 27 is characterized by the rate of surface ratio of heights increasing as the distance from the gate writing side of a liquid crystal panel increases [the rate of surface ratio of the heights of said concavo-convex structure, and a crevice which exists in the part which laps with said gate wiring]. In the transflective LCD with which the transflective layer which consists of the concavo-convex structure where a part laps with the source wiring on a substrate was formed, invention according to claim 28 is characterized by decreasing as the distance from the gate writing side of a liquid crystal panel increases [the electrostatic capacity of the part to which said concavo-convex structure laps with said source wiring].

[0037] In invention according to claim 28, invention according to claim 29 is characterized by increasing as the distance from the gate writing side of a liquid crystal panel increases [the average thickness of the part to which said concavo-convex structure laps with said source wiring]. In invention according to claim 29, invention according to claim 30 is characterized by the rate of surface ratio of heights

increasing as the distance from the gate writing side of a liquid crystal panel increases [the rate of surface ratio of the heights of said concavo-convex structure, and a crevice which exists in the part which laps with said source wiring].
[0038] Invention according to claim 31 is characterized by said electrostatic capacity changing continuously in invention according to claim 25 or 28. Here, the operation effectiveness according to claim 25 to 31 is explained below.
[0039] At the time of a panel drive, by wiring resistance of the gate, gate voltage decreases as the distance from a writing side increases. For this reason, if the capacity of a pixel is the same in a field, a flicker occurs after writing. At this time, the opposite potentials Vcom required for a flicker dissolution differ in a field. Difference deltaVcom of the opposite potential in the ****** location when comparing with Vcom by the side of writing is expressed with the following formulas (1).
[0040]
deltaVcom=[(Cst+Cgd+Csd) /Clc] xdeltaVg -- (1)
capacity Csdbetween Cst:storage capacitance Cgd:gate drains: -- the source -- the difference [0041] of the gate voltage in each location within the field when comparing with the gate voltage initial value by the side of the capacity Clc:liquid crystal capacity deltaVg:writing between drains In order to reduce a flicker, even if the distance from a writing side follows on increasing and deltaVg increases continuously, it is necessary to maintain deltaVcom below at constant value. Therefore, according to the increment in deltaVg, it is necessary to decrease Cst(s), Cgd(s), and all the all [either or].
[0042] The parasitic capacitance by the concavo-convex structure formed in the lap field of gate wiring and a reflecting layer is contained in above Cst in equal circuit. Therefore, the effectiveness of reducing a flicker by decreasing the parasitic capacitance by the concavo-convex structure where the distance from a writing side followed on increasing, and was formed in the lap field of gate wiring and a reflecting layer is acquired. At this time, if the magnitude of the potential fall by resistance of gate wiring has the same wiring width of face, it will increase continuously according to the distance from a writing side. Therefore, a flicker can be reduced still more efficiently by changing the above-mentioned parasitic capacitance continuously.
[0043] Parasitic capacitance can specifically be changed by the average thickness of the concavo-convex structure formed in the lap field of gate wiring and a reflecting layer. It is defined as average thickness here with the value which broke the volume of the lap part of concavo-convex structure by the area of base of a lap part. Moreover, parasitic capacitance can be changed even if it changes the rate of surface ratio of heights and a crevice. If this has many heights of concavo-convex structure, average thickness will increase, and it is because it will decrease if there are many crevices.
[0044] When the flat film is generally used, and changing the value of parasitic capacitance continuously for every pixel, lap area is changed and thickness presupposes that it is fixed. Since thickness is decided by vacuum evaporationo, this is changed for every pixel, because it is difficult. however, when the film of concavo-convex structure is used, even when the thickness at the time of resist vacuum evaporationo is the same, the value of parasitic capacitance changes with the percentage of heights and a crevice easily. On the other hand, by the transflective type panel which has concavo-convex structure, if it laps and parasitic capacitance is changed in the area of the section, the part in which concavo-convex structure is not formed increases, brightness will fall, or the variation in brightness will occur in a field and display grace will fall. However, if the percentage of concavo-convex structure is changed and parasitic capacitance is changed, it will become possible to form concavo-convex structure in the whole surface, and a technical problem like a brightness fall will not be generated. Therefore, it is effective to change the percentage (namely, average thickness) of the heights of concavo-convex structure and a crevice, and to prevent a flicker by the transflective type panel which has the transflective layer which has concavo-convex structure.
[0045] Moreover, the parasitic capacitance of a lap part with source wiring is contained in Csd of a formula (1). Therefore, the effectiveness of reducing a flicker by decreasing the parasitic capacitance by

the concavo-convex structure where the distance from a writing side followed on increasing, and was formed in the lap field of source wiring and a reflecting layer by the same argument as the above is acquired. Moreover, also as for an effective thing, it is the same to change parasitic capacitance by the average thickness of concavo-convex structure.

[0046] In the transflective LCD with which the transflective layer which consists of the concavo-convex structure of having the reflective section and the transparency section was formed, said transparency section is formed in the field which includes the top-most vertices of the heights of said concavo-convex structure at least, and invention according to claim 32 is characterized by having arranged the micro lens at the heights bottom of said concavo-convex structure. Since outgoing radiation is carried out from the transparency section which the light of a back light is condensed by the micro lens and located at the top-most vertices of heights with such a configuration, high brightness-ization at the time of transparency can be attained.

[0047] Invention according to claim 33 is characterized by having the pixel from which the rate of surface ratio of the transparency section differs in the transflective LCD with which the transflective layer which consists of the concavo-convex structure of having the reflective section and the transparency section was formed. In a liquid crystal display, brightness nonuniformity occurs according to the distance from a back light. At this time, there is an inclination for the brightness of a panel to become high, so that it is close to the part to which the back light has been arranged. Therefore, with the location within a field, if the rate of surface ratio of the transparency section of a pixel is changed, equalization of the brightness within a field can be attained. More specifically, the side near a back light should just make small the rate of surface ratio of the transparency section.

[0048] In invention according to claim 33, invention according to claim 34 is not based on the rate of surface ratio of said transparency section, but is characterized by having the range of the rate of surface ratio where a panel reflection factor becomes almost fixed. If the transparency section is prepared in the part where the tilt angle of concavo-convex structure is flat, in order that a flat part may not contribute to a panel reflection factor, it will not be based on the rate of surface ratio of the transparency section, but will become almost fixed [a panel reflection factor]. For this reason, equalization of the brightness within a panel side can be attained by both the time of transparency, and reflex time by the above-mentioned configuration.

[0049] In the transflective LCD with which the transflective layer which consists of the concavo-convex structure where invention according to claim 35 has the reflective section and the transparency section was formed, said transparency section is characterized by being formed in the field to which the tilt angle which said concavo-convex structure has contains a part 10 degrees or more. In the transflective LCD with which the transflective layer which consists of the concavo-convex structure where invention according to claim 36 has the reflective section and the transparency section was formed, said transparency section is characterized by being formed in the field to which the tilt angle which said concavo-convex structure has contains a part 10 degrees [or more] and a part 2 degrees or less.

[0050] There is a strong correlation in inclination distribution of concavo-convex structure, and the reflection property of a panel. For example, when condensing the reflected light in the range of 25 degrees from 0 degree of polar angles by 30-degree incidence, the tilt angle which contributes to condensing is in the range of about 2 to 10 degrees. At this time, the light reflected by the flat part 2 degrees or less turns into specular reflection light, and becomes a poor display. On the other hand, it is reflected in check-by-looking bearing and the opposite side, or the light reflected by the part with a steep tilt angle of 10 degrees or more is shut up inside a panel, turns into light, and does not contribute to condensing. Therefore, as mentioned above, also besides making a flat part into the transparency section, the reflection property in the check-by-looking range cannot change a tilt angle considering a part 10 degrees or more as the transparency section, and the area of the transparency section can increase, and improvement in brightness at the time of transparency can be aimed at.

[0051]

[Embodiment of the Invention] Below, the transflective LCD of this invention is explained with a drawing. (Gestalt 1 of operation) The plan of the array substrate of the transflective LCD concerning the gestalt 1 of operation of this invention in drawing 1 and drawing 2 are the sectional views of the array substrate of the transflective LCD concerning the gestalt 1 of operation of this invention. The transparency section 6 is formed in the field including the top-most vertices (crowning) 7 of the heights of the concavo-convex structure 5 in the reflecting layer (reflective section) 3 which has the concavo-convex structure 5.

[0052] Here, the top-most vertices 7 of the above-mentioned heights are flat, and since they reflect outdoor daylight in mirror plane, they do not contribute to improvement in a reflection factor. Moreover, if a reflecting layer is in a flat part, outdoor daylight will be reflected on the contrary, and tone reversal will occur. Therefore, a transflective LCD can be created, without reducing a reflection factor by making an almost flat field including the part of top-most vertices into the transparency section 6. Moreover, the originating tone reversal resulting from a flat part existing in top-most vertices can also be reduced. the inside of drawing and 1 -- gate wiring and 2 -- source wiring and 3 -- a reflecting layer and 4 -- a contact hole and 8 -- a pixel and 9 -- for the 2nd insulating layer and 12, as for the 1st contact layer and 14, an a-Si layer and 13 are [an array substrate and 10 / the 1st insulating layer and 11 / the 2nd contact layer and 15] transparent electrodes. [in addition,]

[0053] (Gestalt 2 of operation) The plan of the array substrate of the transflective LCD concerning the gestalt 2 of operation of this invention in drawing 3 and drawing 4 are the sectional views of the array substrate of the transflective LCD concerning the gestalt 2 of operation of this invention. The convex reflective section 21 and the transparency section 6 which constitutes an almost flat configuration while being prepared between the these convex reflective sections 21 are formed in the pixel electrode 20, and also it is the almost same configuration as the gestalt 1 of the above-mentioned implementation. While a reflection factor improves by the convex reflective section 21 with such a configuration, the effectiveness that permeability improves further is acquired by existence of the transparency section 6 of a large area.

[0054] Drawing 5 is the sectional view of the array substrate in which another gestalt of the gestalt 2 of operation is shown, and shows the case where the color filter layer 31 is formed on the array substrate 9. The thickness of the color filter layer 31 on a crevice 33 is regulated so that it may be set to d1<d2, when thickness of the color filter layer 31 on d2 and heights 30 is set to d1.

[0055] At this time, the light which carries out incidence as outdoor daylight and which is reflected by the reflecting layer 3 penetrates the part (heights 30 of the color filter layer 31) of the color filter layer 31 from which thickness is d1. By the time outdoor daylight results in a reflecting layer 3, while penetrating the color filter layer 31 at this time, after being reflected by the reflecting layer 3, the color filter layer 31 is penetrated again (that is, outdoor daylight will pass the color filter layer 31 of thickness d1 twice). On the other hand, the transparence light which penetrates and carries out outgoing radiation of the transparent electrode 15 of a crevice 33 penetrates only once the part (crevice 33 of the color filter layer 31) of the color filter layer 31 from which thickness is d2 from a back light 23. Therefore, since the transparence light from a back light 23 will pass the color filter layer 31 of the part to which thickness is large at the time of transparency even if it uses the color filter layer 31 for high reflection of permeability if it is d1<d2 like the above-mentioned configuration, even if it is the case of transparence light, sufficient color reproduction nature will be obtained.

[0056] Moreover, if the thickness d2 of the color filter layer 31 on a crevice 33 is set up so that it may become twice the thickness d1 of the color filter layer 31 on heights 30 in case the thickness of the color filter layer which light penetrates is set up, since the transparency distance of the color filter layer 31 in the transparence light and outdoor daylight from a back light 23 will become equal, the almost same color reproduction nature will be obtained by the time of transparency, and reflex time. in addition, drawing -- setting -- 24 -- for a polarizing plate and 27, as for an opposite substrate and 29, an insulating layer and 28 are [a lamp cover and 25 / a transparent material and 26 / a TFT component

and 32] liquid crystal layers.
[0057] (Gestalt 3 of operation) Drawing 6 is the plan of the array substrate of the transflective LCD concerning the gestalt 3 of operation of this invention. The convex reflective section 21 which has the 1st transparency section 40 in the pixel electrode 20 is formed. The 1st transparency section 40 is formed in the field including the top-most vertices 7 of heights at this time. On the other hand, the 2nd transparency section 41 is formed in the crevice 33 of the pixel electrode 20. Since the 1st transparency section 40 and the 2nd transparency section 41 exist while a reflection factor improves by the convex reflective section 21 if it is such a configuration, the area of the whole transparency section becomes large and the effectiveness of the improvement in permeability is acquired. Moreover, the effectiveness of reducing the specular reflection which originates in a flat part existing in heights top-most vertices by forming the 1st transparency section 40 in a field including the top-most vertices 7 of the convex reflective section 21 is also acquired.
[0058] (Gestalt 4 of operation) The block diagram of the transflective LCD concerning the gestalt 4 of operation of this invention in drawing 7 , drawing 8 (a), and (b) are the plans of the array substrate of the transflective LCD concerning the gestalt 4 of operation of this invention. When a pixel A54 and a pixel B55 existed along the write-in direction 56 of gate potential, the plan of drawing 8 (a) and a pixel B55 was shown for the plan of a pixel A54 in drawing 8 (b). In the lap part 59 of the gate wiring 1 and a pixel 58, depending on the direction of the write-in direction 56, the percentage of each heights of a pixel A54 and a pixel B55 and a crevice has composition with the high percentage of heights, so that it is far from writing side of the gate 57. Thus, if the percentage of heights is high, average thickness will increase and parasitic capacitance will decrease as a result. Since it is such, a flicker can be reduced by this configuration. In addition, for 50, as for a display pixel field and 52, in drawing 8 , a liquid crystal panel and 51 are [Source IC and 53] Gates IC.
[0059] (Gestalt 5 of operation) In the same configuration as the gestalt 4 of operation, the average thickness of the lap parts of source wiring 901 and a pixel 906 constitutes so that it may differ according to the distance from a writing side.
[0060] (Gestalt 6 of operation) Drawing 9 is the sectional view of the transflective LCD concerning the gestalt 6 of operation of this invention. While the transparency section 6 which penetrates the light from a back light (not shown) is formed in a field including the top-most vertices 7 of the heights of the concavo-convex structure 5, the micro lens 70 is formed in the rear-face side. The back light light 71 is condensed by the transparency section 6 by the above-mentioned micro lens 70, and outgoing radiation is carried out. For this reason, if it is original, the light which it is reflected with the rear face of a reflecting layer 3, and does not carry out outgoing radiation to an observer side also becomes possible [penetrating the transparency section 6], and can attain high brightness-ization.
[0061] (Gestalt 7 of operation) Drawing 10 is the block diagram of the transflective LCD display concerning the gestalt 7 of operation of this invention. The back light 23 was arranged in the transparent material 25, and the laminating of a diffusion layer 80 and the transflective type liquid crystal panel 81 grade was carried out on the transparent material 25. And according to the distance from a back light 23, equalization of the brightness within a field can be attained by changing the rate of surface ratio of the transparency section 6 of the pixel of the transflective type liquid crystal panel 81.
[0062] (Gestalt 8 of operation) Drawing 11 is the block diagram of the transflective LCD concerning the gestalt 8 of operation of this invention. After forming the concavo-convex structure 5 on the array substrate 9, the tilt angle of the concavo-convex structure 5 forms a reflecting layer 3 in a field 10 degrees or less. Therefore, as for the transparency section 6, a tilt angle is equivalent to a part 10 degrees or more. By this configuration, since a field 10 degrees or more serves as [the tilt angle which does not contribute to condensing to the check-by-looking direction] the transparency section, a reflection factor cannot change but improvement in brightness at the time of transparency can be aimed at.
[0063]

[Example] Next, the example of this invention is explained.
(Example 1) It is an example corresponding to the gestalt 1 of said operation, and explains using drawing 1 and drawing 2 which were shown with the gestalt 1 of operation. First, after having used silicon oxide, crossing gate wiring to the whole surface in the wrap form and forming the 1st insulating layer 10 on the array substrate 9 with which the gate wiring 1 and source wiring 2 were formed, the a-Si layer 12, the 1st contact layer 13, and the 2nd contact layer 14 were formed on this 1st insulating layer 10, and it considered as the TFT component. Next, after forming the 2nd insulating layer 11 all over a substrate with silicon oxide etc., the photoresist was applied to the whole surface and the concavo-convex structure 5 was formed using mask exposure. Subsequently, after forming a contact hole 4, the transparent electrode 15 was formed, aluminum was vapor-deposited further and the reflecting layer 3 was formed. At this time, aluminum is not vapor-deposited in a field including the top-most vertices 7 of the heights of the concavo-convex structure 5, but the transparency section 6 is formed in the top-most vertices 7 of heights of this. In addition, since it had the reflecting layer 3 while it was making a field including the top-most vertices 7 of heights into the transparency section 6, and back light light penetrated the transparency section 6 and being able to use it as a transparency mold, since the top-most vertices of the heights of concavo-convex structure were almost flat, it became usable also as a reflective mold.
[0064] The rate of surface ratio occupied to the pixel 8 of the transparency section 6 at this time was 30%. And the reflection factor was 30%, when incidence of the diffused light was carried out and the panel reflection factor was measured. The result of having changed the rate of surface ratio of the transparency section from 0% to 100%, and having measured the panel reflection factor was shown in drawing 12 . The measurement result of the transflective LCD which has the transparency section of a configuration conventionally which was shown in drawing 20 and drawing 21 for the comparison was appended to drawing 12 . In the conventional example, an increment of the rate of surface ratio of the transparency section decreased the panel reflection factor in monotone so that clearly from drawing 12 . This is because corresponding to 1:1 in the rate of surface ratio and panel reflection factor of the transparency section in the conventional example.
[0065] On the other hand, in this example, when the rate of surface ratio of the transparency section was small, it was not based on the rate of surface ratio of the transparency section, but the panel reflection factor was almost fixed. At this time, 25% had the almost fixed rate of surface ratio. Although the panel reflection factor decreased according to the increment in the rate of surface ratio, when the same rate of surface ratio compared, the high reflection factor was obtained as compared with the conventional example. Moreover, since permeability corresponded to the rate of surface ratio of the transparency section, and 1:1, when it was the configuration of this example as a result, compared with the configuration of the conventional example, the panel with both high panel reflection factors and permeability was obtained.
[0066] Furthermore, in this example, it was not based on the rate of surface ratio of the transparency section, but the range of the rate of surface ratio where a panel reflection factor becomes almost fixed existed so that clearly from drawing 12 . In order that the field where this has the as small tilt angle of heights as 2 degrees or less may not contribute to a panel reflection factor, it is for a panel reflection factor not changing considering the field where a tilt angle is small as the transparency section. Moreover, that a panel reflection factor will fall if the rate of surface ratio of the transparency section becomes large originates in the part which has the tilt angle which contributes to a panel reflection factor serving as the transparency section, if the rate of surface ratio of the transparency section increases.
[0067] In addition, although the transparency section may form the top-most vertices of heights in the symmetry as a core, it may not be limited to this and may be asymmetrically formed to the top-most vertices of heights. If the transparency section becomes large, the transparency section will exist in the part of the inclination which contributes to the reflective engine performance, and a reflection factor will

fall. As shown in drawing 13 , when forming the transparency section 6 in heights at this time, permeability can be secured without reducing a reflection factor by forming many reflecting layers 3 in a side with many amounts of incidence of outdoor daylight in consideration of the check-by-looking direction of a panel, and forming many transparency sections 6 in a panel lower part side (the inside of drawing, down) including top-most vertices 7. That is, when forming the transparency section 6 which includes the top-most vertices 7 of heights 30 in outdoor daylight side 101 of drawing 13 , and observer side 10, it is desirable to form the transparency section 6 for increasing in observer side 102.
[0068] Moreover, it is necessary to form the transparency section 6 near [no / top-most-vertices 7] heights 30, and it may be formed in some heights 30 in consideration of extent of tone reversal. Thus, if the transparency section 6 is formed in some heights 30, a reflection factor can be adjusted easily. Furthermore, the configuration of the transparency section may not be limited to the configuration shown in above-mentioned drawing 13 R> 3, and as shown in drawing 14 R> 4, it may be prepared in the hemihedry located in the observer 103 side of heights. In this case, even if outdoor daylight 104 reflects with an observer's 103 body and it carries out incidence to a panel from an observer side, in order to carry out outgoing radiation of the outdoor daylight 104 to a rear-face side from the transparency section 6, reflected decreases and the effectiveness that visibility improves is demonstrated.
[0069] In addition, as shown in drawing 15 , the cross-section configuration of heights 30 may be set as the non-object, and the transparency section 6 may be further formed in the steep inclined plane located in an observer 103 side. At this time, the brightness at the time of transparency improves by condensing using an optical element 105 and carrying out incidence of the back light light 71 aslant from the transparency section 6 of heights 30. Moreover, since the whole surface will serve as a reflecting layer 3 mostly if it sees from a top face, it is effective in a reflection factor improving. Moreover, it is not necessary to necessarily form a transparent electrode in the reflecting layer bottom, and it may be formed in the reflecting layer bottom. Moreover, even if a transparent electrode is not the whole surface, it should just be in a part. For example, if it is the configuration which requires some transparent electrodes for a surrounding reflecting layer including the transparency section, a flow can fully be aimed at. Furthermore, if the area of the transparency section is small, even if there is no transparent electrode in the transparency section, the electric-field response of the liquid crystal on the transparency section will be attained by the surrounding reflecting layer and the electric field during opposite, and the same effectiveness as the above will be acquired. For example, when a panel gap is 10 micrometers, as long as the transparency section is 8 micrometers or less, there may be no transparent electrode. Moreover, a panel gap is the same even if the transparency section is 3 micrometers or less in about 5 micrometers.
[0070] In addition, heights 30 do not necessarily need to have top-most vertices, and may be trapezoid configurations like drawing 16 . In this case, the same effectiveness is acquired by making the top face of a trapezoid configuration into the transparency section 6. Moreover, from a top, the configuration of the seen heights 30 may not be circular and a polygon is sufficient as it. Thus, if the flat-surface configuration of heights 30 is made into a polygon, the azimuth of an inclined plane can set it as arbitration, and the effectiveness of adjusting viewing-angle bearing will be born.
[0071] Furthermore, as for the ratio of the transparency section and a reflecting layer, changing according to the main operation is desirable. For example, if use on the outdoors is main, 60% or more of the ratio of a reflecting layer is good. Since the reflection factor of the usual reflective mold panel is about 35%, if the ratio of the reflective section is 60% or more, the reflection factor of a panel will become 20% or more, and the level which can enough be checked by looking will be obtained. A good display is obtained because the model used as a transparency mold like the pocket mold note PC on the other hand in many cases makes the ratio of the transparency section high.
[0072] In addition, although the field with a tilt angle of 2 degrees or less was used as a flat part in the above-mentioned example 1, it does not limit to this. Generally, in a field with the tilt angle near 0 degree, the panel reflection factor in the check-by-looking direction near specular reflection is

determined, and the field where a tilt angle is large determines the panel reflection factor in the include angle which is separated from specular reflection. Although the reflection factor in the location near the direction of specular reflection will fall if it follows, for example, the tilt angle of 4 degrees or less is defined as a flat field, the panel reflection factor in the check-by-looking direction distant from specular reflection does not change, but the panel whose permeability improved is obtained.

[0073] (Example 2) It is an example corresponding to the gestalt 2 of said operation, and explains using drawing 3 and drawing 4 which were shown with the gestalt 2 of operation. Although it is the almost same configuration as the gestalt 1 of operation, while forming a reflecting layer only in the heights of the concavo-convex structure 5 and considering as the convex reflective section 21, it differs at the point made into the structure of making a back light penetrating by making a crevice into almost flat structure, and making this flat crevice into the transparency section by considering a resist as a configuration further.

[0074] Here, since the resist was made into 1 lamination like the above, if simplification of a manufacture process can be attained and the convex reflective section 21 is further formed with conductors, such as aluminum, it can be used as an electrode by connecting with the transparent electrode 15 of a crevice electrically. Under the present circumstances, if the gap of the liquid crystal layer of a crevice is made into twice the gap of the liquid crystal layer in heights, the retardation of a liquid crystal layer will become the same by the time of transparency, and reflex time. Since the rate of light modulation of a liquid crystal layer becomes the same also at the time of reflex time and transparency at this time, brightness improves. Moreover, what is necessary is just to set 6 micrometers and liquid crystal thickness of heights to about 3 micrometers for the liquid crystal thickness of a crevice at the time of the design of a liquid crystal layer. Moreover, it is desirable to be able to twist the liquid crystal of a liquid crystal layer and to make an angle into the range of 40 to 90 degrees according to the reason for both obtaining high brightness at reflex time and the time of transparency.

[0075] Furthermore, what is necessary is to be able to change the rate of surface ratio of heights and a crevice according to the application of a panel, for example, just to change the rate of surface ratio of the crevice to a pixel 8 in 20 to 70% of range.

[0076] Drawing 17 is a plan concerning another gestalt of an array substrate, it is the convex reflective section's 21 being mutually connected through a connection 110, and connecting with a contact hole 4 further, and the convex reflective section 21 acts as a reflector. Thus, when the convex reflective section 21 is produced in the mutually connected configuration, there is an advantage that electrical installation between the electrode of the reflective section and a contact hole can be planned easily. Moreover, a connection 110 does not need to be the not necessarily same height as the convex reflective section 21, and as long as it can connect the convex reflective section 21 electrically mutually, it may be thin. Moreover, if a connection 110 is made from the same height as the convex reflective section 21, the effectiveness that a reflection property improves will be acquired according to tilt-angle distribution of connection 1906 the very thing.

[0077] (Example 3) It is an example corresponding to another gestalt of the gestalt 2 of said operation, and explains using drawing 5 shown with the gestalt 2 of operation. First, on the insulating layer 27, the transparent electrode 15 was vapor-deposited, and further, heights 30 were formed so that it might become height of 3 micrometers, and width of face of 9 micrometers. It was made into the flat crevice 33 between heights 30, and width of face of this crevice 33 was set to 3 to 5 micrometers. Moreover, since the reflecting layer 3 is formed in the above-mentioned heights 30, a crevice 33 turns into the transparency section. At this time, the rate of surface ratio of the transparency section to a pixel 8 was made into 48%.

[0078] Next, the color filter ingredient was applied and the color filter layer 31 of RGB was formed for every pixel by patterning processing. At this time, since the pitch of a crevice 33 and heights 30 was as small as several micrometers - about 10 micrometers, the color filter ingredient had the thick crevice 33, and heights 30 were applied to the thin configuration. Specifically, the thickness of the color filter layer

31 was 1 micrometer in the crevice 33 at 1.9 micrometers and heights. Thus, the thickness at the time of spreading of a color filter ingredient can differ, and the thickness of the color filter layer 31 can be made to differ as a result by using the concavo-convex structure 5 where a pitch is small.

[0079] Then, the panel was formed so that the thickness of the liquid crystal layer of heights 30 might be set to 3 micrometers, and it considered as the transflective LCD. Here, reflex time and the time of transparency estimated the display engine performance of a panel. Consequently, since the transparency section was prepared in the flat part, the value with a as high reflection factor as 35% was acquired. Moreover, the rate of surface ratio of the transparency section was also as high as 40%. In addition, since the thickness of a color filter layer was making it differ by the crevice and heights, what also has the almost same color reproduction nature was obtained in reflex time and the time of transparency.

[0080] In addition, what is necessary is not to limit the configuration of heights and a crevice, and the thickness of a color filter layer to the above-mentioned value, and just to form [0.5 micrometers to 2 micrometers, and the reflective section] the thickness of a color filter layer by 0.25 to about 1 micrometer in the transparency section that heights should just be 1 to about 5 micrometers in height.

[0081] (Example 4) It is an example corresponding to the gestalt 3 of said operation, and explains using drawing 6 shown with the gestalt 3 of operation. The field which includes the top-most vertices 7 of the 2nd transparency section 41 and the convex reflective section 21 for the crevice of the pixel electrode 20 was made into the 1st transparency section 40. Since a flat part serves as the transparency section over the whole region mostly with such a configuration, the improvement in brightness at the time of a transparency mold and the effectiveness of specular reflection prevention of reflex time are acquired.

[0082] (Example 5) It is an example corresponding to the gestalt 4 of said operation, and explains using drawing 7 shown with the gestalt 4 of operation and drawing 8 (a), and (b). When width of face of the gate wiring 1 was set to 4 micrometers, the pixel 58 was considered as the configuration which laps with the gate wiring 1 by the width of face of 1.5 micrometer. At this time, an adjacent pixel inter-electrode distance was 1 micrometer. And when spreading resist thickness at the time of creating the concavo-convex structure 5 was set to 3 micrometers, the maximum level difference of the concavo-convex structure 5 after development was 2 micrometers. Moreover, the thickness of the insulating layer formed in the bottom of a resist could be 1.5 micrometers. Therefore, in the field with which the gate wiring 1 and a pixel 58 lapped, the thickness to the base of 4.5 micrometers and a crevice of the thickness from the gate wiring 1 to the top-most vertices of the heights of the concavo-convex structure 5 was 2.5 micrometers.

[0083] On the other hand, according to the distance from writing side of gate potential 57, the rate of surface ratio of the heights 30 of the concavo-convex structure 5 and a crevice 33 which exists in the lap part 59 of the gate wiring 1 and a pixel 58 was changed continuously. At this time, the rate of surface ratio of heights 30 was made high as it separated from writing side 57 along the write-in direction 56. Specifically, the ratio of heights 30 was changed from 20% to 90% in the screen. If the rate of surface ratio of heights 30 and a crevice 33 is correlated with average thickness and heights 30 are increased, the same operation will be demonstrated as average thickness increases.

[0084] Since the value of parasitic capacitance was optimized in a field by this configuration according to a fall degree even if gate potential falls by wiring resistance, the flicker decreased sharply to 100mV or less, and the good display was obtained. In addition, although gate potential is single-sided electric supply in the above-mentioned example, it does not limit to this and, of course, both-sides electric supply is sufficient. Thus, if it writes in and parasitic capacitance is changed according to bearing also when it considers as both-sides electric supply, the same operation as the above and effectiveness will be demonstrated. When it considers as both-sides electric supply, specifically, the design of parasitic capacitance serves as bilateral symmetry for every line. Since the concavo-convex structure of a lap part contributes to the reflective engine performance, when it is made both-sides electric supply, it is effective in that the reflective engine performance in every line is equalized, and equalization of a display

can plan.
[0085] Moreover, although the above-mentioned example changed the surface ratio of the concavo-convex structure of the lap part of a pixel and gate wiring, it may not be limited to this and may change the surface ratio of the concavo-convex structure of the lap parts of source wiring and a pixel. Moreover, even if it changes the surface ratio of the lap part of the both sides of gate wiring and source wiring, there is same effectiveness. And the value of parasitic capacitance can be further adjusted to arbitration by changing the both sides of gate wiring and source wiring.
[0086] (Example 6) It is an example corresponding to the gestalt 6 of said operation, and explains using drawing 9 shown with the gestalt 6 of operation. First, after forming the gate wiring 1 and 1st insulating-layer 10 grade on the array substrate 9, the micro lens 70 was created using ultraviolet curing mold resin. Next, after carrying out flattening of the whole using the 2nd insulating layer 11, the concavo-convex structure 5 grade was formed. At this time, the top-most vertices 7 of a crevice 33 were made into the transparency section. By repeating lens arrangement of a micro lens 70, and arrangement of heights 30, it was condensed by the micro lens 70 and the back light light 71 considered as the configuration which carries out outgoing radiation from the transparency section 6. At this time, lens width of face of a micro lens 70 was set to 10 micrometers, and thickness was set to 1.5 micrometer. Moreover, width of face of heights was set to 12 micrometers.
[0087] Like the above, since it was condensed by the micro lens 70 and the back light light 71 carried out outgoing radiation from the transparency section 6 by forming a micro lens 70 in the heights 30 bottom (that is, the rate that the back light light 71 is reflected by the reflecting layer 3 can be reduced), brightness improved by that. And when were experimented about the brightness property and a micro lens 70 was formed, it was admitted compared with the case where a micro lens 70 is not formed that brightness increased 120%.
[0088] In addition, the 2nd insulating layer 11 may not be limited to the structure of forming on a micro lens 70, and may be formed in the micro-lens 70 bottom. It becomes possible using such structure, then the lens configuration of a micro lens 70 to form heights 30. If the 2nd insulating layer 11 is used, the transparency section 6 of heights 30 can be formed according to the focal distance of a micro lens 70, and the condensing effectiveness of back light light will improve. It is desirable to use a 1 to about 5 micrometers thing as a focal distance of a micro lens 70 from a viewpoint which controls the increment in the thickness of the 2nd insulating layer 11.
[0089] (Example 7) It is an example corresponding to the gestalt 7 of said operation, and explains using drawing 10 shown with the gestalt 7 of operation. According to the distance from a back light 23, the rate of surface ratio of the transparency section of a pixel was changed. The relation between the relative position in a panel, the rate of surface ratio of the transparency section, and a ** panel reflection factor was shown in drawing 18 . As for the relative position in a panel, the back light side specified 0 and the opposite side as 1. When changing the rate of surface ratio to 50% (relative position 1) from 35% (relative position 0) as are shown in drawing 18 , and it kept away from the back light, the panel reflection factor decreased from 35% to 30%. However, it is thought that extent of reduction is very small and is a reflection factor almost uniform in a field. Moreover, although not shown in drawing 18 , it was admitted that the transparency reinforcement of back light light was also almost uniform in a field.
[0090] Thus, the uniform brightness within a field is [both] realizable by the time of transparency, and reflex time adjusting the rate of surface ratio of the transparency section of a pixel to a panel according to the intensity distribution of the back light at the time of carrying out incidence. In addition, if the transparency section is prepared in the flat part of concavo-convex structure as shown in said drawing 12 , the field where a panel reflection factor does not change even if it changes the rate of surface ratio of the transparency section will be obtained. For this reason, if the rate of surface ratio in within the limits of the above-mentioned field is mainly used even if it changes the rate of surface ratio of the transparency section by the pixel in a panel, even if it changes the rate of surface ratio of the

transparency section within a panel, a panel reflection factor can be mostly made regularity.
[0091] (Example 8) It is an example corresponding to the gestalt 8 of said operation, and explains using drawing 11 shown with the gestalt 8 of operation. The concavo-convex structure 5 was formed in width of face of 10 micrometers, and height of 3 micrometers on the array substrate 9. Drawing 19 is a graph which shows tilt-angle distribution of the concavo-convex structure 5. The tilt angle was missing from 10 degrees from 0 degree, and distribution increased almost in monotone and decreased in monotone with a peak of 10 degrees. The greatest tilt angle was 20 degrees.
[0092] In consideration of the above-mentioned thing, the tilt angle of the concavo-convex structure 5 formed the reflecting layer 3 in the field 10 degrees or more using the aluminum containing alloy. At this time, the rate of surface ratio of the transparency section 91 and the reflective section 90 was pixel surface ratio, the transparency section 91 was 40% and the reflective section 90 was 60%. When the reflection factor was investigated with such a configuration, in order that the transparency section 91 in the concavo-convex structure 5 might not contribute to condensing of reflex time, the value with a as high reflection factor as 30% was acquired. On the other hand, since there was 40% of the transparency sections 91 by pixel surface ratio, high brightness was obtained also in the time of transparency.
[0093] In addition, although the tilt angle made only the field 10 degrees or more the transparency section in the above-mentioned example, it does not limit to this and is good also as the transparency section also including a flat part [as / whose tilt angle is 2 degrees or less]. Since the area of the transparency section increases preventing decline in a reflection factor with such a configuration since a flat part does not contribute to condensing, further high brightness-ization can be attained at the time of transparency.
[0094] Moreover, a tilt angle may not limit the field of the transparency section only to a field 10 degrees or more, and a tilt angle may form it in fields, such as 12 degrees or more and 15 etc. degrees or more. And if a tilt angle makes a field 12 degrees or more the transparency section, when the check-by-looking range will make a field 15 degrees or more as breadth and a tilt angle will make it the transparency section to -5 degrees by the polar angle, it is effective in the check-by-looking range spreading to -10 degrees in a polar angle.
[0095]
[Effect of the Invention] As mentioned above, according to this invention, permeability can be improved, without falling a reflection factor to a reflecting layer by making the comparatively flat part of a reflecting layer transparent with the transflective type liquid crystal panel of the back light method which has the transparency section. Moreover, the effectiveness of flicker reduction is acquired by gate potential writing in the concavo-convex structure of the lap parts of the gate, source wiring, and a pixel, and changing according to bearing.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] Drawing 1 is the plan of the array substrate of the transflective LCD concerning the gestalt 1 of operation.

[Drawing 2] Drawing 2 is the sectional view of the array substrate of the transflective LCD concerning the gestalt 1 of operation.

[Drawing 3] Drawing 3 is the plan of the array substrate of the transflective LCD concerning the gestalt 2 of operation.

[Drawing 4] Drawing 4 is the sectional view of the array substrate of the transflective LCD concerning the gestalt 2 of operation.

[Drawing 5] Drawing 5 is the sectional view of the array substrate in which another gestalt of the gestalt 2 of operation is shown.

[Drawing 6] Drawing 6 is the plan of the array substrate of the transflective LCD concerning the gestalt 3 of operation.

[Drawing 7] Drawing 7 is the block diagram of the transflective LCD concerning the gestalt 4 of operation of this invention.

[Drawing 8] Drawing 8 (a) and (b) are the plan of the array substrate of the transflective LCD concerning the gestalt 4 of operation of this invention.

[Drawing 9] Drawing 9 is the sectional view of the transflective LCD concerning the gestalt 6 of operation of this invention.

[Drawing 10] Drawing 10 is the block diagram of the transflective LCD display concerning the gestalt 7 of operation of this invention.

[Drawing 11] Drawing 11 is the block diagram of the transflective LCD concerning the gestalt 8 of operation of this invention.

[Drawing 12] The graph which shows the relation between the rate of surface ratio of the transparency section, and a panel reflection factor

[Drawing 13] Drawing 13 is the plan showing the modification of the array substrate of the transflective LCD concerning an example 1.

[Drawing 14] Drawing 14 is the plan showing other modifications of the array substrate of the transflective LCD concerning an example 1.

[Drawing 15] Drawing 15 is the plan showing the modification of further others of the array substrate of the transflective LCD concerning an example 1.

[Drawing 16] Drawing 16 is the plan showing other modifications of the array substrate of the transflective LCD concerning an example 1.

[Drawing 17] Drawing 17 is the plan showing the modification of the array substrate of the transflective LCD concerning an example 2.

[Drawing 18] Drawing 18 is a graph which shows the relation between the relative position in a panel, the rate of surface ratio of the transparency section, and a ** panel reflection factor.

[Drawing 19] Drawing 19 is a graph which shows tilt-angle distribution of the concavo-convex structure 5.

[Drawing 20] Drawing 20 is the plan of the array substrate of the conventional transflective LCD.

[Drawing 21] Drawing 21 is the sectional view of the array substrate of the conventional transflective LCD.

[Drawing 22] For drawing 22 (a), drawing 22 (b) is the explanatory view showing the beam-of-light locus in the reflecting layer in the conventional transflective LCD, and the explanatory view showing the beam-of-light locus in the reflecting layer in the transflective LCD of this invention.

[Drawing 23] Drawing 23 is the explanatory view showing the beam-of-light locus in the reflecting layer

in the transflective LCD concerning other examples of this invention.
[Drawing 24] Drawing 24 (a) is the plan of an array substrate which prepared the reflective section in an observer and the opposite side widely, and drawing 24 (b) is the plan of an array substrate which prepared the reflective section in the observer side widely.
[Description of Notations]
1 Gate Wiring
2 Source Wiring
3 Reflecting Layer
4 Contact Hole
5 Concavo-convex Structure
6 Transparency Section
7 Top-most Vertices
8 Pixel
9 Array Substrate

[Translation done.]

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	5/08			5/08	Ｚ
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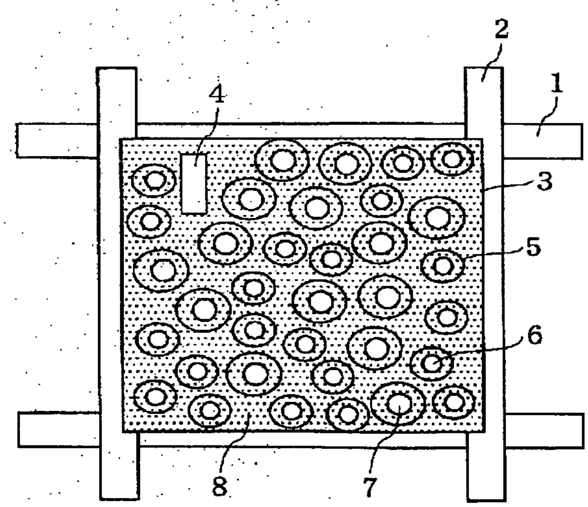
(71)出願人 000005821
松下電器産業株式会社
大阪府門真市大字門真1006番地

(72)発明者 久保田 浩史
大阪府門真市大字門真1006番地 松下電器産業株式会社内

(74)代理人 100101823
弁理士 大前 要

(54)【発明の名称】 半透過型液晶表示装置

(57)【要約】 (修正有)
【課題】半透過型液晶パネルの反射率と透過率の向上を図ることを目的とする。
【解決手段】反射層３と透過部６とを有する凹凸構造５から成る半透過層が形成された半透過型液晶表示装置において、前記透過部６が、前記凹凸構造５のほぼ平坦な部分を含む領域に形成されたことを特徴とする。凹凸構造のほぼ平坦な部分（即ち、傾斜角が極めて小さな部分）は、パネル反射率に寄与しないばかりか、鏡面反射となるためかえって表示性能が低下する原因となる。そこで、上記構成の如く、凹凸構造のほぼ平坦な部分を含む領域に透過部を形成すれば、鏡面反射を防止できると共に、透過部が存在することによりバックライトからの光透過率を向上させることできる。



【特許請求の範囲】

【請求項１】反射部と透過部とを有する凹凸構造から成る半透過層が形成された半透過型液晶表示装置において、
前記透過部が、前記凹凸構造のほぼ平坦な部分を含む領域に形成されたことを特徴とする半透過型液晶表示装置。

【請求項２】前記平坦な部分の前期凹凸構造が有する傾斜角が、０°以上２°以下であることを特徴とする請求項１記載の半透過型液晶表示装置。

【請求項３】前記平坦な部分の前記凹凸構造が有する傾斜角が、０°以上４°以下であることを特徴とする請求項１記載の半透過型液晶表示装置。

【請求項４】前記透過部の少なくとも一部が透明電極を有しないことを特徴とする請求項１記載の半透過型液晶表示装置。

【請求項５】前記透過部が透明電極を有することを特徴とする請求項１記載の半透過型液晶表示装置。

【請求項６】反射部と透過部とを有する凹凸構造から成る半透過層が形成された半透過型液晶表示装置において、
前記透過部が、少なくとも前記凹凸構造の凸部の一部を含む領域に形成されたことを特徴とする半透過型液晶表示装置。

【請求項７】前記透過部が、前記凸部の頂点を含み、更に前記頂点を中心として対称に形成されたことを特徴とする請求項６記載の半透過型液晶表示装置。

【請求項８】前記透過部が、前記凸部の頂点を含み、更に前記頂部に対して非対称に形成されたことを特徴とする請求項６記載の半透過型液晶表示装置。

【請求項９】前記透過部が、凸部の半面に設けられていることを特徴とする、請求項６記載の半透過型液晶表示装置。

【請求項１０】前記凸部の断面が複数の傾斜面から成る非対称形状を有し、前記透過部が前記非対称形状の急峻な傾斜面に設けられていることを特徴とする請求項６記載の半透過型液晶表示装置。

【請求項１１】反射部と透過部とを有する凹凸構造から成る半透過層が形成された半透過型液晶表示装置において、
前記凹凸構造の凸部の断面形状が台形状であり、且つ、前記透過部が、少なくとも前記台形形状の上面の一部を含む領域に形成されたことを特徴とする半透過型液晶表示装置。

【請求項１２】前記凸部の上面形状が、多角形であることを特徴とする請求項１１記載の半透過型液晶表示装置。

【請求項１３】反射部と透過部とを有する凹凸構造から成る半透過層が形成された半透過型液晶表示装置において、
前記透過部が、少なくとも前記凹凸構造の凹部の底部を含む領域に形成されたことを特徴とする半透過型液晶表示装置。

【請求項１４】前記凹凸構造の凹部が底部を有し、更に凹部の底部が平坦であることを特徴とする請求項１３記載の半透過型液晶表示装置。

【請求項１５】前記反射部が、前記凸部の頂部に対して非対称に形成されたことを特徴とする請求項１３記載の半透過型液晶表示装置。

【請求項１６】前記反射部が、前記凸部の半面に設けられたことを特徴とする請求項１５記載の半透過型液晶表示装置。

【請求項１７】反射部と透過部とを有する凹凸構造から成る半透過層が形成された半透過型液晶表示装置において、
前記透過部が、少なくとも前記凹凸構造の凸部の頂点を含む領域と、凹部の底部を含む領域に形成されたことを特徴とする半透過型液晶表示装置。

【請求項１８】前記凸部の頂点と、透過部が形成された前記凹部との領域が、ほぼ平坦であることを特徴とする請求項１７記載の半透過型液晶表示装置。

【請求項１９】前記透過部が、互いに独立して形成されたことを特徴とする請求項８又は１１記載の半透過型液晶表示装置。

【請求項２０】前記透過部が、ランダムに配置されたことを特徴とする請求項１９記載の半透過型液晶表示装置。

【請求項２１】前記透過部が、互いに一部が繋がった連続的な形状から形成されたことを特徴とする請求項１３又は１７記載の半透過型液晶表示装置。

【請求項２２】前記反射部が、互いに一部が繋がった連続的な形状から形成されたことを特徴とする請求項１３又は１７記載の半透過型液晶表示装置。

【請求項２３】前記凹凸構造上に、カラーフィルタ層が形成され、前記凹凸構造における凸部上のカラーフィルタ層の厚みをｄ１、凹部上のカラーフィルタ層の厚みをｄ２としたときに、ｄ１＜ｄ２が成り立つことを特徴とする請求項１３又は１７記載の半透過型液晶表示装置。

【請求項２４】前記ｄ２が、前記ｄ１の略２倍であることを特徴とする請求項２３記載の半透過型液晶表示装置。

【請求項２５】基板上のゲート配線と一部が重なる凹凸構造から成る半透過層が形成された半透過型液晶表示装置において、
前記凹凸構造が前記ゲート配線と重なる部分の静電容量が、液晶パネルのゲート書き込み側からの距離が増加するに従い、減少することを特徴とする半透過型液晶表示装置。

【請求項２６】前記凹凸構造が前記ゲート配線と重なる部分の平均的な層厚が、液晶パネルのゲート書き込み側

からの距離が増加するに従い、増加することを特徴とする請求項２５記載の半透過型液晶表示装置。

【請求項２７】前記ゲート配線と重なる部分に存在する前記凹凸構造の凸部と凹部の面積比率が、液晶パネルのゲート書き込み側からの距離が増加するに従い、凸部の面積比率が増加することを特徴とする請求項２６記載の半透過型液晶表示装置。

【請求項２８】基板上のソース配線と一部が重なる凹凸構造から成る半透過層が形成された半透過型液晶表示装置において、

前記凹凸構造が前記ソース配線と重なる部分の静電容量が、液晶パネルのゲート書き込み側からの距離が増加するに従い、減少することを特徴とする半透過型液晶表示装置。

【請求項２９】前記凹凸構造が前記ソース配線と重なる部分の平均的な層厚が、液晶パネルのゲート書き込み側からの距離が増加するに従い、増加することを特徴とする請求項２８記載の半透過型液晶表示装置。

【請求項３０】前記ソース配線と重なる部分に存在する前記凹凸構造の凸部と凹部の面積比率が、液晶パネルのゲート書き込み側からの距離が増加するに従い、凸部の面積比率が増加することを特徴とする請求項２９記載の半透過型液晶表示装置。

【請求項３１】前記静電容量が連続的に変化することを特徴とする請求項２５又は２８記載の半透過型液晶表示装置。

【請求項３２】反射部と透過部とを有する凹凸構造から成る半透過層が形成された半透過型液晶表示装置において、

前記透過部が、少なくとも前記凹凸構造の凸部の頂点を含む領域に形成され、前記凹凸構造の凸部の下側にマイクロレンズが配置されたことを特徴とする半透過型液晶表示装置。

【請求項３３】反射部と透過部とを有する凹凸構造から成る半透過層が形成された半透過型液晶表示装置において、

前記透過部の面積比率が異なる画素を有することを特徴とする半透過方液晶表示装置。

【請求項３４】前記透過部の面積比率によらず、パネル反射率がほぼ一定となる面積比率の範囲を有することを特徴とする請求項３３記載の半透過型液晶表示装置。

【請求項３５】反射部と透過部とを有する凹凸構造から成る半透過層が形成された半透過型液晶表示装置において、

前記透過部が、前記凹凸構造の有する傾斜角が１０°以上の部分を含む領域に形成されたことを特徴とする半透過型液晶表示装置。

【請求項３６】反射部と透過部とを有する凹凸構造から成る半透過層が形成された半透過型液晶表示装置において、

前記透過部が、前記凹凸構造の有する傾斜角が１０°以上の部分と、２°以下の部分とを含む領域に形成されたことを特徴とする半透過型液晶表示装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、高輝度で低消費電力が実現できる半透過型液晶表示装置に関する。

【０００２】

【従来の技術】モバイル端末等の急速な普及に伴い、反射型液晶パネルが注目されているが、この反射型液晶パネルは外光を反射して表示を行なうため、屋外等の外光が強い環境では充分な表示性能が得られる一方、暗い屋内や夜間では視認性が極端に低下するという課題がある。

【０００３】そこで、反射型液晶パネルを応用し屋外と屋内を兼用できる物として半透過型液晶パネルが提案されている。このような半透過型液晶パネルは、バックライト構成を用いた場合に凹凸形状の反射層の一部に透過部を設け、この透過部を画素中央に四角形状で設けるるような構造であった。また、作成条件の容易さを考慮して、上記凹凸構造は画素毎に同一の構造をとるのが通例であった（特開平１０－３１９４２２号公報参照）。

【０００４】

【発明が解決しようとする課題】しかしながら、上記の如く、反射層の画素中央に大きく透過部を設ける手法では、透過部の全ての部分が反射に寄与しないため、反射型として用いた場合に充分な輝度が得られない課題があった。また、透過型の場合の輝度は透過部の面積で決まるが、上記の如く凹凸構造に関係なく透過部を設けると、反射時の反射率と透過時の透過率とが両立し得ないという課題もある。

【０００５】更に、カラーフィルタ層が透過時と反射時で同じ層厚であった場合、反射時と透過時とで光の吸収度合いが異なり、透過時と反射時とで色相が異なるという課題があった。これは、反射時には、光がカラーフィルター層を往復するため、実質的なカラーフィルタ層の厚みが、透過時の２倍となるということに起因するものと考えられる。この結果、例えば、反射率を優先して反射用の透過率の高いカラーフィルタを用いると、透過時に色が薄くなるという課題もあった。

【０００６】加えて、凹凸構造は画素毎にほぼ同一の構成であったため、画素の容量構成も画面内で同一である。このため、大画面化を図った場合には、ゲートやソースの配線抵抗に起因するゲート電圧低下で突き抜け電圧の値が面内で異なり、フリッカーが発生するという課題もあった。

【０００７】

【課題を解決するための手段】上記課題を解決するために、本発明は凹凸構造の有する半透過反射層を用いたバックライト構成の半透過型液晶表示装置において、以下

の手段を講じた。

【０００８】請求項１記載の発明は、反射部と透過部とを有する凹凸構造から成る半透過層が形成された半透過型液晶表示装置において、前記透過部が、前記凹凸構造のほぼ平坦な部分を含む領域に形成されたことを特徴とする。凹凸構造のほぼ平坦な部分（即ち、傾斜角が極めて小さな部分）は、パネル反射率に寄与しないばかりか、鏡面反射となるためかえって表示性能が低下する原因となる。そこで、上記構成の如く、凹凸構造のほぼ平坦な部分を含む領域に透過部を形成すれば、鏡面反射を防止できると共に、透過部が存在することによりバックライトからの光透過率を向上させることができる。尚、具体的な作用効果については、下記請求項２の作用効果において説明する。

【０００９】請求項２に記載の発明は、請求項１記載の発明において、前記平坦な部分の前期凹凸構造が有する傾斜角が、０°以上２°以下であることを特徴とする。凹凸構造を有する半透過層の反射性能は、反射部の凹凸構造が有する傾斜角で決定される。このとき、周囲から入射する光を効率的に観察者方向に集光するには、傾斜角は２°から１０°程度を特定の分布で配置する必要がある。このとき、傾斜角が２°以下と小さい凹凸は鏡面反射に近くなり光を集光する効果が小さい。また鏡面反射により階調反転が発生し視認性が極端に低下する。したがって、２°以下と小さい傾斜角を有する箇所は、パネル反射率に寄与しないか、鏡面反射のためかえって表示性能が低下する原因となる。このため、従来は、傾斜角が小さい部分を設けないように反射層を形成することに重点がおかれていた。しかし、本発明者らはバックライトを有する半透過型ディスプレイでは、傾斜角が小さい部分を透過部とすることで鏡面反射を防ぐと共に、パネル反射率の向上を図ることができることを見出した。

【００１０】そこで、本発明の具体的な作用効果を、従来の技術との比較において、以下に説明する。図２０は従来の半透過型液晶表示装置の液晶パネルにおけるアレイ基板の上面図、図２１は従来の半透過型液晶表示装置の液晶パネルにおけるアレイ基板の断面図である。従来は、レジストで凹凸構造２０４を形成する際に、平坦部が極力発生しない構成とすることにより反射層２０２の傾斜角が小さくなるのを防止していた。但し、どのように凹凸構造２０４を形成しても、凸部の頂点は平坦となるため、平坦部にも反射層２０２が形成される構造であった。その一方、画素の中央部に反射層２０２を設けない透過部２０５を大きく設けることにより半透過型としていたため、透過部における凹凸構造２０４は全く反射率に寄与していなかった。

【００１１】図２２（ａ）は従来の半透過型液晶パネルの反射層での光線軌跡の一例を示す説明図である。凹凸構造の傾斜部での反射光２１０は輝度向上に寄与するが、凸部頂点付近での正反射光２１１は階調反転の一因となっている。また、透過部２１３の凸部の傾斜部には透明電極２１４のみが形成されており凹凸構造に係わらず透過光２１５が発生する。このため透過部２１３の凸部の傾斜部はパネル反射率に全く寄与しない構造であった。

【００１２】これに対して、本発明の半透過型液晶表示装置は、反射層の凹凸構造での平坦な部分を透過部とすることで、パネル反射率の低下を防ぐとともに透過時の輝度向上を図る。そして、このようにパネル反射率に寄与しない部分を透過部とすることで、反射率と透過率との向上の両立を図ることができる。

【００１３】図２２（ｂ）は本発明の半透過型液晶パネルの反射層での光線軌跡の一例を示す説明図である。凸部の頂点付近には透明電極３００を有する透過部３０１が形成されている。本構成を用いることで、反射性能に寄与する傾斜面での反射光３０２は画素全面で発生し、パネル反射率が向上する。一方、従来構成では階調反転が発生していた凸部頂点付近を透過部３０１とすることで階調反転が低減し、なおかつバックライトの透過率も確保することが可能となる。このような作用効果が発揮されるのは、パネル透過率は透過部のトータルの面積で決まるためである。

【００１４】請求項３に記載の発明は、請求項１記載の発明において、前記平坦な部分の前記凹凸構造が有する傾斜角が、０°以上４°以下であることを特徴とする。このように、傾斜角４°以下を平坦な領域と定義すると、正反射方向に近い位置での反射率は低下するが、正反射方向から離れた視認方向でのパネル反射率は変わらず、透過率が一層向上したパネルが得られる。

【００１５】請求項４に記載の発明は、請求項１記載の発明において、前記透過部の少なくとも一部が透明電極を有しないことを特徴とする。前記透過部の面積が小さければ、透過部に透明電極が無くても周囲の反射層と対向間の電界で透過部上の液晶の電界応答が可能となるため、上記と同様の作用効果が発揮される。

【００１６】請求項５に記載の発明は、請求項１記載の発明において、前記透過部が透明電極を有することを特徴とする。上記の如く、透過部の面積が小さければ、透過部に透明電極が無くても良いが、透過部の面積が大きければ、透過部に透明電極が存在するのが望ましいという理由による。

【００１７】請求項６に記載の発明は、反射部と透過部を有する凹凸構造から成る半透過層が形成された半透過型液晶表示装置において、前記透過部が、少なくとも前記凹凸構造の凸部の一部を含む領域に形成されたことを特徴とする。凸部中には平坦な部分が存在するので、その部分を含む領域を透過部とすれば、請求項１と同様の作用効果を発揮する。

【００１８】請求項７に記載の発明は、請求項６記載の発明において、前記透過部が、前記凸部の頂点を含み、

更に前記頂点を中心として対称に形成されたことを特徴とする。上記構成の如く、透過部を凹凸構造の少なくとも凸部の頂点を含む領域に形成すると、頂点は凹凸構造における平坦な部分となるので、パネル反射率の低下を防ぐとともに透過時の輝度向上を図ることができる。即ち、凸部の頂点の如く、パネル反射率に寄与しない部分を透過部とすることで、反射率と透過率との向上の両立を図ることができる。

【００１９】請求項８に記載の発明は、請求項６記載の発明において、前記透過部が、前記凸部の頂点を含み、更に前記頂部に対して非対称に形成されたことを特徴とする。

【００２０】請求項９に記載の発明は、請求項６記載の発明において、前記透過部が、凸部の半面に設けられていることを特徴とする。上記構成の如く、透過部が凸部の半面に設けられていれば（具体的には、観察者側に位置する凸部の半面に主として透過部を設ける一方、その反対側の凸部の半面に反射層を設けていれば）、観察者の体で外光が反射し、観察者側からパネルに入射しても、外光は透過部から裏面側に出射するため、映りこみが減少し、この結果、視認性が向上する。

【００２１】請求項１０に記載の発明は、請求項６記載の発明において、前記凸部の断面が複数の傾斜面から成る非対称形状を有し、前記透過部が前記非対称形状の急峻な傾斜面に設けられていることを特徴とする。上記構成であれば、観察者側に急峻な傾斜面を位置させた場合には、バックライト光が凸部の透過部から斜めに入射することで、透過時の輝度が向上する。また、上面から見るとほぼ全面が反射層となるため、反射率も向上するという効果がある。

【００２２】請求項１１に記載の発明は、反射部と透過部とを有する凹凸構造から成る半透過層が形成された半透過型液晶表示装置において、前記凹凸構造の凸部の断面形状が台形状であり、前記透過部が、少なくとも前記台形形状の上面の一部を含む領域に形成されたことを特徴とする。台形形状の上面は平坦であるので、その一部を含む領域に透過部を形成すれば上記と同様の作用効果が得られる。

【００２３】請求項１２に記載の発明は、請求項１１記載の発明において、前記凸部の上面形状が、多角形であることを特徴とする。凸部の平面形状を多角形にすると、傾斜面の方位角が任意に設定でき、視角方位を容易に調整するという作用効果がある。

【００２４】請求項１３に記載の発明は、反射部と透過部とを有する凹凸構造から成る半透過層が形成された半透過型液晶表示装置において、前記透過部が、少なくとも前記凹凸構造の凹部の底部を含む領域に形成されたことを特徴とする。

【００２５】請求項１４に記載の発明は、請求項１３記載の発明において、前記凹凸構造の凹部が底部を有し、更に凹部の底部が平坦であることを特徴とする。少なくとも凹部の平坦部を含む領域に透過部が形成されていれば、凹部の平坦部はパネル反射率に寄与しないということから、上記と同様にパネル反射率と透過率との向上を図ることができる。具体的に、図２３を用いて説明する。図２３は、本発明の半透過型液晶パネルの反射層での光線軌跡の一例を示す説明図である。凸部４００間の部分４０１をほぼ平坦とし、当該部分４０１を透過部とすることにより、反射率と透過率との向上を図ることができる。

【００２６】請求項１５に記載の発明は、請求項１３記載の発明において、前記反射部が、前記凸部の頂部に対して非対称に形成されたことを特徴とする。請求項１６に記載の発明は、請求項１５記載の発明において、前記反射部が、前記凸部の半面に設けられたことを特徴とする。

【００２７】図２４に示すように、前記反射部が前記凸部の頂部に非対称に設けられると、上述したのと同様の原理で、外光を効果的に観察者方向に集光することができる。このとき、図２４（ａ）のように、反射部を観察者と反対側に広く設けると、観察者と反対側から入射する外光を効果的に集光できる。一方、図２４（ｂ）のように、反射部を観察者側に広く設けると、観察者の体で反射した外光や観察者の背後から入射する光を効果的に集光できる。また、図２４（ａ）と図２４（ｂ）とのパターンを、適量混在させると、それぞれの集光特性を混在率により平均化させることができ、より効果的に集光特性を調整することができる。

【００２８】請求項１７に記載の発明は、反射部と透過部を有する凹凸構造から成る半透過層が形成された半透過型液晶表示装置において、前記透過部が、少なくとも前記凹凸構造の凸部の頂点を含む領域と、凹部の底部を含む領域とに形成されたことを特徴とする。このような構成であれば、反射率と透過率とをより一層向上させることができる。

【００２９】請求項１８に記載の発明は、請求項１７記載の発明において、前記凸部の頂点と、透過部が形成された前記凹部との領域が、ほぼ平坦であることを特徴とする。請求項１９に記載の発明は、請求項８又は１１記載の発明において、前記透過部が、互いに独立して形成されたことを特徴とする。

【００３０】請求項２０に記載の発明は、請求項１９記載の発明において、前記透過部が、ランダムに配置されたことを特徴とする。このように透過部の配置をランダムにすると、回折が発生せず、色づきや輝度ムラがないパネルを得ることができる。

【００３１】請求項２１に記載の発明は、請求項１３又は１９記載の発明において、前記透過部が、互いに一部が繋がった連続的な形状から形成されたことを特徴とする。請求項２２に記載の発明は、請求項１３又は１９記

載の発明において、前記反射部が、互いに一部が繋がった連続的な形状から形成されたことを特徴とする。反射部を導電性材料で形成した場合、反射部を互いに一部が繋がった連続的な形状とすることで、コンタクトホールにおける電気的接続を容易に図ることができる。

【００３２】請求項２３に記載の発明は、請求項１３又は１７記載の発明において、前記凹凸構造上に、カラーフィルタ層が形成され、前記凹凸構造における凸部上のカラーフィルタ層の厚みをｄ１、凹部上のカラーフィルタ層の厚みをｄ２としたときに、ｄ１＜ｄ２が成り立つことを特徴とする。

【００３３】外光として入射し、反射層で反射する光は、層厚がｄ１となっているカラーフィルタ層の部分を透過するが、この際、外光は反射層に至るまでにカラーフィルタ層を透過すると共に、反射層で反射された後に再度カラーフィルタ層を透過する（即ち、外光は層厚ｄ１のカラーフィルタ層を２回通過することになる）。一方、バックライトから凹部を透過して出射する透明光は、層厚がｄ２となっているカラーフィルタ層を１回だけ透過する。したがって、上記の構成であれば、透過率の高い反射用のカラーフィルタ層を用いても、透過時に層厚が大きくなっている部分のカラーフィルタ層を、バックライトからの透明光が通過することになるので、透明光の場合であっても十分な色再現性が得られることになる。

【００３４】請求項２４に記載の発明は、請求項２３記載の発明において、前記ｄ２が、前記ｄ１の略２倍であることを特徴とする。上記構成であれば、バックライトからの透明光と外光とにおけるカラーフィルタ層の透過距離が等しくなるので、透過時と反射時とで、ほぼ同様の色再現性が得られる。

【００３５】請求項２５に記載の発明は、基板上のゲート配線と一部が重なる凹凸構造から成る半透過層が形成された半透過型液晶表示装置において、前記凹凸構造が前記ゲート配線と重なる部分の静電容量が、液晶パネルのゲート書き込み側からの距離が増加するに従い、減少＊することを特徴とする。請求項２６に記載の発明は、請求項２５記載の発明において、前記凹凸構造が前記ゲート配線と重なる部分の平均的な層厚が、液晶パネルのゲート書き込み側からの距離が増加するに従い、増加することを特徴とする。

【００３６】請求項２７に記載の発明は、請求項２６記載の発明において、前記ゲート配線と重なる部分に存在する前記凹凸構造の凸部と凹部の面積比率が、液晶パネルのゲート書き込み側からの距離が増加するに従い、凸部の面積比率が増加することを特徴とする。請求項２８に記載の発明は、基板上のソース配線と一部が重なる凹凸構造から成る半透過層が形成された半透過型液晶表示装置において、前記凹凸構造が前記ソース配線と重なる部分の静電容量が、液晶パネルのゲート書き込み側からの距離が増加するに従い、減少することを特徴とする。

【００３７】請求項２９に記載の発明は、請求項２８記載の発明において、前記凹凸構造が前記ソース配線と重なる部分の平均的な層厚が、液晶パネルのゲート書き込み側からの距離が増加するに従い、増加することを特徴とする。請求項３０に記載の発明は、請求項２９記載の発明において、前記ソース配線と重なる部分に存在する前記凹凸構造の凸部と凹部の面積比率が、液晶パネルのゲート書き込み側からの距離が増加するに従い、凸部の面積比率が増加することを特徴とする。

【００３８】請求項３１に記載の発明は、請求項２５又は２８記載の発明において、前記静電容量が連続的に変化することを特徴とする。ここで、請求項２５～３１記載の作用効果について、以下に説明する。

【００３９】パネル駆動時には、ゲートの配線抵抗によりゲート電圧が書き込み側からの距離が増加するに従い減少する。このため、面内で画素の容量が同一なら書き込み後にフリッカーが発生する。このとき、フリッカー解消に必要な対向電位Ｖｃｏｍは面内で異なる。書き込み側のＶｃｏｍと比較したときの面内各位置における対向電位の差ΔＶｃｏｍは、以下の式（１）で表される。

【００４０】

$$\Delta Vcom = \left[(Cst + Cgd + Csd) / Clc \right] \times \Delta Vg \cdots (1)$$

Ｃｓｔ：蓄積容量

Ｃｇｄ：ゲートドレイン間容量

Ｃｓｄ：ソースドレイン間容量

Ｃｌｃ：液晶容量

ΔＶｇ：書き込み側のゲート電圧初期値と比較したときの面内の各位置におけるゲート電圧の差

【００４１】フリッカーを低減するためには、書き込み側からの距離が増加するに伴いΔＶｇが連続的に増加しても、ΔＶｃｏｍを一定値以下に保つ必要がある。したがってΔＶｇの増加に従い、Ｃｓｔ、Ｃｇｄ、及びＣｓｄのいずれかもしくは全てを減少させる必要がある。

【００４２】ゲート配線と反射層の重なり領域に形成された凹凸構造による寄生容量は、等価回路的には上記のＣｓｔに含まれる。したがって、書き込み側からの距離が増加するに伴いゲート配線と反射層の重なり領域に形成された凹凸構造による寄生容量を減少させることでフリッカーを低減する効果が得られる。このとき、ゲート配線の抵抗による電位低下の大きさは、配線幅が同一であれば書き込み側からの距離に応じて連続的に増加する。したがって、上記の寄生容量も連続的に変化させることでフリッカーをさらに効率的に低減することができる。

【００４３】寄生容量は、具体的にはゲート配線と反射層の重なり領域に形成された凹凸構造の平均的な層厚で変化させることができる。ここで平均的な層厚とは、凹凸構造の重なり部分の体積を、重なり部分の底面積で割

った値で定義される。また、凸部と凹部の面積比率を変えても寄生容量を変化させせることができる。これは、凹凸構造の凸部が多ければ平均的な層厚は増加し、凹部が多ければ減少することによる。

【００４４】一般に平坦な膜を用いた場合、画素毎に寄生容量の値を連続的に変化させるときは重なり面積を変化させ膜厚は一定とする。これは、膜厚は蒸着で決まるため画素毎に変えるのは困難なためである。しかし、凹凸構造の膜を用いた場合は凸部と凹部の構成比により、レジスト蒸着時の膜厚が同じでも容易に寄生容量の値が変化する。一方、凹凸構造を有する半透過型パネルで、寄生容量を重なり部の面積で変えると凹凸構造が形成されない部分が増加して輝度が低下したり、面内で輝度のバラツキが発生し表示品位が低下する。しかし、凹凸構造の構成比を変えて寄生容量を変えれば、凹凸構造を全面に形成することが可能となり輝度低下のような課題は発生しない。したがって、凹凸構造を有する半透過層を有する半透過型パネルでは、凹凸構造の凸部と凹部との構成比（すなわち平均的な膜厚）を変化させてフリッカーを防止するのが有効である。

【００４５】また、ソース配線との重なり部分の寄生容量は式（１）のＣｓｄに含まれる。したがって、上記と同じ議論で、書き込み側からの距離が増加するに伴いソース配線と反射層の重なり領域に形成された凹凸構造による寄生容量を減少させることでフリッカーを低減する効果が得られる。また、凹凸構造の平均的な膜厚で寄生容量を変えることが有効なことも同じである。

【００４６】請求項３２に記載の発明は、反射部と透過部とを有する凹凸構造から成る半透過層が形成された半透過型液晶表示装置において、前記透過部が、少なくとも前記凹凸構造の凸部の頂点を含む領域に形成され、前記凹凸構造の凸部の下側にマイクロレンズが配置されたことを特徴とする。このような構成であれば、マイクロレンズによりバックライトの光が集光されて、凸部の頂点に位置する透過部から出射するので、透過時の高輝度化を図ることができる。

【００４７】請求項３３に記載の発明は、反射部と透過部とを有する凹凸構造から成る半透過層が形成された半透過型液晶表示装置において、透過部の面積比率が異なる画素を有することを特徴とする。液晶表示装置ではバックライトからの距離に従い、輝度ムラが発生する。このとき、バックライトが配置された部位に近いほどパネルの輝度が高くなる傾向がある。したがって、面内位置により、画素の透過部の面積比率を変えると面内輝度の均一化を図ることができる。具体的には、バックライトに近い側ほど、透過部の面積比率を小さくすれば良い。

【００４８】請求項３４に記載の発明は、請求項３３記載の発明において、前記透過部の面積比率によらず、パネル反射率がほぼ一定となる面積比率の範囲を有することを特徴とする。凹凸構造の傾斜角が平坦な部位に透過

部を設けると、平坦部はパネル反射率に寄与しないため、透過部の面積比率によらず、パネル反射率がほぼ一定となる。このため、上記構成により透過時と反射時の両方でパネル面内輝度の均一化を図ることができる。

【００４９】請求項３５に記載の発明は、反射部と透過部とを有する凹凸構造から成る半透過層が形成された半透過型液晶表示装置において、前記透過部が、前記凹凸構造の有する傾斜角が１０°以上の部分を含む領域に形成されたことを特徴とする。請求項３６に記載の発明は、反射部と透過部とを有する凹凸構造から成る半透過層が形成された半透過型液晶表示装置において、前記透過部が、前記凹凸構造の有する傾斜角が１０°以上の部分と、２°以下の部分とを含む領域に形成されたことを特徴とする。

【００５０】凹凸構造の傾斜分布と、パネルの反射特性とには強い相関関係がある。例えば、３０°入射で、極角０°から２５°の範囲に反射光を集光する場合、集光に寄与する傾斜角は、ほぼ２°から１０°の範囲にある。このとき、２°以下の平坦な部位で反射した光は、正反射光となり表示不良となる。一方、１０°以上の急峻な傾斜角の部位で反射した光は、視認方位と反対側に反射されるか、パネル内部で閉じ込め光となって、集光には寄与しない。したがって、上述したように、平坦な部分を透過部とする以外にも、傾斜角が１０°以上の部位を透過部としても、視認範囲での反射特性は変わらず、かつ透過部の面積が増えて、透過時の輝度向上を図ることができる。

【００５１】

【発明の実施の形態】以下では、本発明の半透過型液晶表示装置について図面と共に説明する。

（実施の形態１）図１は本発明の実施の形態１に係わる半透過型液晶表示装置のアレイ基板の上面図、図２は本発明の実施の形態１に係わる半透過型液晶表示装置のアレイ基板の断面図である。凹凸構造５を有する反射層（反射部）３において、凹凸構造５の凸部の頂点（頂部）７を含む領域に透過部６が形成されている。

【００５２】ここで、上記凸部の頂点７は平坦であり外光を鏡面的に反射するため反射率の向上には寄与しない。また、平坦な部分に反射層があるとかえって外光が映り込み階調反転が発生する。したがって、頂点の部位を含むほぼ平坦な領域を透過部６とすることで反射率を低減することなく半透過型液晶表示装置を作成できる。また、頂点に平坦部が存在することに起因する起因する階調反転も低減できる。尚、図中、１はゲート配線、２はソース配線、３は反射層、４はコンタクトホール、８は画素、９はアレイ基板、１０は第１絶縁層、１１は第２絶縁層、１２はａ－Ｓｉ層、１３は第１コンタクト層、１４は第２コンタクト層、１５は透明電極である。

【００５３】（実施の形態２）図３は本発明の実施の形態２に係わる半透過型液晶表示装置のアレイ基板の上面

図、図４は本発明の実施の形態２に係わる半透過型液晶表示装置のアレイ基板の断面図である。画素電極２０には、凸状反射部２１と、これら凸状反射部２１間に設けられると共にほぼ平坦な形状を成す透過部６が形成される他は、上記実施の形態１とほぼ同様の構成である。このような構成であれば、凸状反射部２１により反射率が向上すると共に、大面積の透過部６の存在により、一層透過率が向上するという効果が得られる。

【００５４】図５は、実施の形態２の別形態を示すアレイ基板の断面図であり、カラーフィルタ層３１をアレイ基板９上に形成した場合を示す。凹部３３上のカラーフィルタ層３１の層厚をｄ２、凸部３０上のカラーフィルタ層３１の層厚をｄ１としたとき、ｄ１＜ｄ２となるように規制している。

【００５５】このとき、外光として入射し、反射層３で反射する光は、層厚がｄ１となっているカラーフィルタ層３１の部分（カラーフィルタ層３１の凸部３０）を透過する。このとき、外光は反射層３に至るまでにカラーフィルタ層３１を透過すると共に、反射層３で反射された後に再度カラーフィルタ層３１を透過する（即ち、外光は層厚ｄ１のカラーフィルタ層３１を２回通過することになる）。一方、バックライト２３から凹部３３の透明電極１５を透過して出射する透明光は、層厚がｄ２となっているカラーフィルタ層３１の部分（カラーフィルタ層３１の凹部３３）を１回だけ透過する。したがって、上記の構成の如くｄ１＜ｄ２であれば、透過率の高い反射用のカラーフィルタ層３１を用いても、透過時に層厚が大きくなっている部分のカラーフィルタ層３１を、バックライト２３からの透明光が通過することになるので、透明光の場合であっても十分な色再現性が得られることになる。

【００５６】また、光が透過するカラーフィルタ層の厚みを設定する際、凹部３３上のカラーフィルタ層３１の層厚ｄ２を、凸部３０上のカラーフィルタ層３１の層厚ｄ１の２倍となるように設定すれば、バックライト２３からの透明光と外光とにおけるカラーフィルタ層３１の透過距離が等しくなるので、透過時と反射時とで、ほぼ同様の色再現性が得られることになる。尚、図において、２４はランプカバー、２５は導光体、２６は偏光板、２７は絶縁層、２８は対向基板、２９はＴＦＴ素子、３２は液晶層である。

【００５７】（実施の形態３）図６は本発明の実施の形態３に係わる半透過型液晶表示装置のアレイ基板の上面図である。画素電極２０に、第１透過部４０を有する凸状反射部２１が形成されている。このとき、第１透過部４０は凸部の頂点７を含む領域に形成されている。一方画素電極２０の凹部３３には第２透過部４１が形成されている。このような構成とすると、凸状反射部２１により反射率が向上する一方、第１透過部４０と第２透過部４１が存在するので、透過部全体の面積が大きくなって、透過率向上の効果が得られる。また、凸状反射部２１の頂点７を含む領域に第１透過部４０を設けることで、凸部頂点に平坦部が存在するということに起因する鏡面反射を低減する効果も得られる。

【００５８】（実施の形態４）図７は本発明の実施の形態４に係わる半透過型液晶表示装置の構成図、図８（ａ）（ｂ）は本発明の実施の形態４に係わる半透過型液晶表示装置のアレイ基板の上面図である。ゲート電位の書き込み方向５６に沿って画素Ａ５４、及び画素Ｂ５５が存在するとき、画素Ａ５４の上面図を図８（ａ）、画素Ｂ５５の上面図を図８（ｂ）に示した。ゲート配線１と画素５８との重なり部分５９において、画素Ａ５４と画素Ｂ５５のそれぞれの凸部と凹部の構成比は書き込み方向５６の方向に依存し、ゲートの書き込み側５７から遠いほど凸部の構成比が高い構成となっている。このように、凸部の構成比が高いと、平均的な膜厚が増加し、結果として寄生容量が減少する。このようなことから、本構成によりフリッカーを低減することができる。尚、図８において、５０は液晶パネル、５１は表示画素領域、５２はソースＩＣ、５３はゲートＩＣである。

【００５９】（実施の形態５）実施の形態４と同様の構成において、ソース配線９０１と画素９０６の重なり部分の平均的な膜厚が、書き込み側からの距離に応じて異なるように構成している。

【００６０】（実施の形態６）図９は、本発明の実施の形態６に係わる半透過型液晶表示装置の断面図である。凹凸構造５の凸部の頂点７を含む領域にバックライト（図示せず）からの光を透過する透過部６が設けられる一方、裏面側にマイクロレンズ７０が形成されている。上記マイクロレンズ７０によりバックライト光７１が、透過部６に集光され出射する。このため、本来なら反射層３の裏面で反射されて観察者側に出射しない光も透過部６を透過することが可能となり、高輝度化を図ることができる。

【００６１】（実施の形態７）図１０は、本発明の実施の形態７に係わる半透過型液晶表示装置表示の構成図である。バックライト２３を導光体２５に配設し、導光体２５上に拡散層８０、半透過型液晶パネル８１等を積層した。そして、バックライト２３からの距離に応じて、半透過型液晶パネル８１の画素の透過部６の面積比率を変えることで、面内輝度の均一化を図ることができる。

【００６２】（実施の形態８）図１１は、本発明の実施の形態８に係わる半透過型液晶表示装置の構成図である。アレイ基板９上に凹凸構造５を形成した後、反射層３を凹凸構造５の傾斜角が１０°以下の領域に形成する。したがって、透過部６は、傾斜角が１０°以上の部位に相当する。本構成により、視認方向への集光に寄与しない傾斜角が１０°以上の領域が透過部となるため、反射率が変わらず透過時の輝度向上を図ることができる。

【0063】
【実施例】次に、本発明の実施例を説明する。
（実施例１）前記実施の形態１に対応する実施例であり、実施の形態１にて示した図１及び図２を用いて説明する。先ず、ゲート配線１やソース配線２が形成されたアレイ基板９上に、酸化シリコンを用いてゲート配線を覆う形で全面に渡り第１絶縁層１０を形成した後、この第１絶縁層１０上にａ－Ｓｉ層１２、第１コンタクト層１３、及び第２コンタクト層１４を形成してＴＦＴ素子とした。次に、酸化シリコン等で基板全面に第２絶縁層１１を形成した後、フォトレジストを全面に塗布しマスク露光を用いて凹凸構造５を形成した。次いで、コンタクトホール４を形成した後、透明電極１５を形成し、更にアルミを蒸着して反射層３を形成した。このとき、凹凸構造５の凸部の頂点７を含む領域にはアルミを蒸着せず、これによって凸部の頂点７には透過部６が形成される。尚、凹凸構造の凸部の頂点はほぼ平坦であるため、凸部の頂点７を含む領域を透過部６とすることで、透過部６をバックライト光が透過して透過型として使用できると共に、反射層３を有するので、反射型としても使用可能となった。
【0064】このときの透過部６の画素８に占める面積比率は３０％であった。そして、パネル反射率を、拡散光を入射して測定したところ、反射率は３０％であった。透過部の面積比率を、０％から１００％まで変えてパネル反射率を測定した結果を図１２に示した。図１２には、比較のために、図２０及び図２１に示した従来形状の透過部を有する半透過型液晶表示装置の測定結果を付記した。図１２から明らかなように、従来例では、透過部の面積比率が増加すると、パネル反射率は単調に減少した。これは、従来例では、透過部の面積比率とパネル反射率とが１：１に対応するためである。
【0065】一方、本実施例においては、透過部の面積比率が小さいときは、透過部の面積比率によらず、パネル反射率はほぼ一定であった。このとき、面積比率が２５％までは、ほぼ一定であった。面積比率の増加に従い、パネル反射率は減少したが、同一の面積比率で比較した場合、従来例に比較して高い反射率が得られた。また、透過率は、透過部の面積比率と１：１に対応するため、結果として、本実施例の構成であれば、従来例の構成に比べて、パネル反射率と透過率とが共に高いパネルが得られた。
【0066】更に、図１２から明らかなように、本実施例では、透過部の面積比率によらず、パネル反射率がほぼ一定となる面積比率の範囲が存在した。これは、凸部の傾斜角が２°以下と小さい領域は、パネル反射率に寄与しないため、傾斜角が小さい領域を透過部としても、パネル反射率は変化しないためである。また、透過部の面積比率が大きくなると、パネル反射率が低下するのは、透過部の面積比率が増加すると、パネル反射率に寄与する傾斜角を有する部位も透過部となってしまうことに起因するものである。
【0067】尚、透過部は凸部の頂点を中心として対称に形成しても良いが、これに限定するものではなく、凸部の頂点に対しては非対称に形成しても良い。透過部が大きくなると、反射性能に寄与する傾斜の部分に透過部が存在することになり、反射率が低下する。このとき、図１３に示すように、凸部に透過部６を設ける場合に、パネルの視認方向を考慮して外光の入射量が多い側に反射層３を多く設け、頂点７を含んだパネル下方側（図中、下方向）に透過部６を多く設けることで反射率を低減することなく透過率を確保することができる。つまり、図１３の外光側１０１と観察者側１０とに凸部３０の頂点７を含む透過部６を形成する場合に、透過部６を観察者側１０２に多くなるに形成するのが望ましい。
【0068】また、透過部６は、全ての凸部３０の頂点７付近に形成する必要はなく、階調反転の程度を考慮して一部の凸部３０に形成しても良い。このように、一部の凸部３０に透過部６を形成すると、容易に反射率を調整することができる。更に、透過部の形状は、上記図１３に示した形状に限定するものではなく、例えば、図１４に示すように、凸部の観察者１０３側に位置する半面に設けても良い。この場合には、観察者１０３の体で外光１０４が反射し、観察者側からパネルに入射しても、外光１０４は透過部６から裏面側に出射するため、映りこみが減少し、視認性が向上するという効果が発揮される。
【0069】加えて、図１５に示すように、凸部３０の断面形状を非対象とし、さらに、観察者１０３側に位置するその急峻な傾斜面に透過部６を設けても良い。このとき、バックライト光７１を光学素子１０５を用いて集光して、凸部３０の透過部６から斜めに入射することで、透過時の輝度が向上する。また、上面から見るとほぼ全面が反射層３となるため、反射率も向上する効果がある。また、透明電極は、必ずしも反射層の下側に形成する必要はなく、反射層の上側に形成しても良い。また、透明電極は全面でなくとも一部に有れば良い。例えば、透過部を含み周囲の反射層に透明電極の一部がかかるような形状であれば、十分に導通を図ることができる。更に、透過部の面積が小さければ、透過部に透明電極が無くても周囲の反射層と対向間の電界で透過部上の液晶の電界応答が可能となり、上記と同様の効果が得られる。例えば、パネルギャップが１０μｍの場合、透過部が８μｍ以下であれば透明電極は無くても良い。また、パネルギャップが５μｍ程度で、透過部が３μｍ以下であっても同様である。
【0070】加えて、凸部３０は必ずしも頂点を有してなくても良く、図１６のように台形形状であっても良い。この場合、台形形状の上面を透過部６とすることで同様の効果が得られる。また、上から見た凸部３０の形

状は円形でなく多角形でも良い。このように、凸部３０の平面形状を多角形にすると、傾斜面の方位角が任意に設定でき、視角方位を調整する効果が生まれる。

【００７１】更に、透過部と反射層との比率は、主な使用方法に応じて変えるのが望ましい。例えば、屋外での使用が主であれば、反射層の比率は６０％以上が良い。通常の反射型パネルの反射率は３５％程度であるため、反射部の比率が６０％以上であればパネルの反射率は２０％以上となり十分に視認可能なレベルが得られる。一方、携帯型ノートＰＣのように透過型として使用する場合が多い機種は、透過部の比率を高くすることで良好な表示が得られる。

【００７２】加えて、上記実施例１では、平坦な部位として傾斜角２°以下の領域を用いたが、これに限定するものではない。一般に、傾斜角が０°に近い領域では、正反射に近い視認方向でのパネル反射率を決定し、傾斜角が大きい領域は、正反射から離れた角度でのパネル反射率を決定する。したがって、例えば、傾斜角４°以下を平坦な領域と定義すると、正反射方向に近い位置での反射率は低下するが、正反射方向から離れた視認方向でのパネル反射率は変わらず、透過率が向上したパネルが得られる。

【００７３】（実施例２）前記実施の形態２に対応する実施例であり、実施の形態２にて示した図３及び図４を用いて説明する。実施の形態１とほぼ同様の構成であるが、凹凸構造５の凸部にのみ反射層を形成し凸状反射部２１とすると共に、レジストを一層構成とすることで、凹部を、ほぼ平坦な構造とし、且つ、この平坦な凹部を透過部とすることでバックライトを透過させる構造とした点で異なる。

【００７４】ここで、上記の如く、レジストを１層構成としたので、製造プロセスの簡略化を図ることができ、更に、凸状反射部２１をアルミ等の導電体で形成すれば、凹部の透明電極１５と電気的に接続することで、電極として使用できる。この際、凹部の液晶層のギャップを、凸部における液晶層のギャップの２倍とすると、液晶層のリタデーションが透過時と反射時とで同じになる。このとき反射時も透過時も液晶層の光変調率が同じとなるため、輝度が向上する。また、液晶層の設計時には、例えば、凹部の液晶層厚を６μｍ、凸部の液晶層厚を３μｍ程度とすれば良い。また、反射時と透過時とに、共に高い輝度を得るという理由により、液晶層の液晶の捻じれ角は４０°から９０°の範囲とするのが望ましい。

【００７５】更に、凸部と凹部との面積比率は、パネルの用途に応じて変えることができ、例えば、画素８に対する凹部の面積比率を２０％から７０％の範囲で変化させれば良い。

【００７６】図１７は、アレイ基板の別形態に係る上面図であり、凸状反射部２１が互いに接続部１１０を介して接続され、更にコンタクトホール４に接続されることで、凸状反射部２１は反射電極として作用する。このように、凸状反射部２１を互いに接続した形状で作製すると、反射部の電極とコンタクトホールとの間の電気的接続が容易に図れるという利点がある。また、接続部１１０は凸状反射部２１と必ずしも同様の高さである必要はなく、凸状反射部２１を互いに電気的に接続できれば薄くても良い。また、接続部１１０を、凸状反射部２１と同様の高さで作れば、接続部１９０６自体の傾斜角分布により、反射特性が向上する効果が得られる。

【００７７】（実施例３）前記実施の形態２の別形態に対応する実施例であり、実施の形態２にて示した図５を用いて説明する。先ず、絶縁層２７上に、透明電極１５を蒸着し、さらに凸部３０を高さ３μｍ、幅９μｍとなるように形成した。凸部３０間は平坦な凹部３３とし、この凹部３３の幅は３μｍから５μｍとした。また、上記凸部３０には反射層３を設けているので、凹部３３が透過部となる。このとき、画素８に対する透過部の面積比率は４８％とした。

【００７８】次に、カラーフィルタ材料を塗布し、パターニング処理でＲＧＢのカラーフィルタ層３１を画素毎に形成した。このとき、凹部３３と凸部３０とのピッチが数μｍ～１０μｍ程度と小さいため、カラーフィルタ材料は、凹部３３が厚く、凸部３０が薄い形状に塗布された。具体的には、カラーフィルタ層３１の層厚は、凹部３３では１．９μｍ、凸部では１μｍであった。このように、ピッチの小さい凹凸構造５を用いることで、カラーフィルタ材料の塗布時における膜厚が異なり、この結果カラーフィルタ層３１の層厚を異ならしめることができる。

【００７９】この後、凸部３０の液晶層の層厚が３μｍとなるようにパネルを形成し、半透過型液晶表示装置とした。ここで、パネルの表示性能を、反射時と透過時とで評価した。その結果、透過部を平坦部に設けたため、反射率は３５％と高い値が得られた。また、透過部の面積比率も４０％と高かった。加えて、凹部と凸部とでカラーフィルタ層の層厚が異ならしめているので、反射時と透過時とで色再現性もほぼ同様のものが得られた。

【００８０】尚、凸部と凹部との形状、及びカラーフィルタ層の層厚は上記の値に限定するものではなく、凸部は１μｍから５μｍ程度の高さであれば良く、またカラーフィルタ層の層厚は、透過部では０．５μｍから２μｍ、反射部では０．２５μｍから１μｍ程度で形成すれば良い。

【００８１】（実施例４）前記実施の形態３に対応する実施例であり、実施の形態３にて示した図６を用いて説明する。画素電極２０の凹部を第２透過部４１と、凸状反射部２１の頂点７を含む領域を第１透過部４０とした。このような構成であれば、平坦な部分がほぼ全域にわたって透過部となるため、透過型時の輝度向上と反射

時の鏡面反射防止の効果が得られる。

【００８２】（実施例５）前記実施の形態４に対応する実施例であり、実施の形態４にて示した図７及び図８（ａ）（ｂ）を用いて説明する。ゲート配線１の幅を４μｍとしたときに、画素５８をゲート配線１と１．５μｍの幅で重なる構成とした。このとき、隣り合う画素電極間の距離は１μｍであった。そして、凹凸構造５を作成する際の塗布レジスト厚を３μｍとしたとき、現像後の凹凸構造５の最大段差は２μｍであった。また、レジストの下に形成した絶縁層の層厚は１．５μｍとした。したがって、ゲート配線１と画素５８とが重なった領域では、ゲート配線１から凹凸構造５の凸部の頂点までの厚みは４．５μｍ、凹部の底辺までの厚みは２．５μｍであった。

【００８３】一方、ゲート電位の書き込み側５７からの距離に応じて、ゲート配線１と画素５８との重なり部分５９に存在する凹凸構造５の凸部３０と凹部３３の面積比率を連続的に変化させた。このとき、書き込み方向５６に沿って書き込み側５７から離れるに従い凸部３０の面積比率を高くした。具体的には、画面内で凸部３０の比率を２０％から９０％まで変化させた。凸部３０と凹部３３との面積比率は平均的な膜厚と相関しており、凸部３０を増加されれば、平均的な膜厚が増加することと同様の作用が発揮される。

【００８４】本構成により、配線抵抗によりゲート電位が低下しても寄生容量の値が低下度合に合わせて面内で最適化されるため、フリッカーが１００ｍＶ以下に大幅に低減し良好な表示が得られた。尚、上記例では、ゲート電位は片側給電であるが、これに限定するものではなく、両側給電でも良いことは勿論である。このように、両側給電とした場合も書き込み方位に応じて寄生容量を変えれば上記と同様の作用、効果が発揮される。具体的には、両側給電とした場合には、１ライン毎に寄生容量の設計が左右対称となる。重なり部分の凹凸構造は反射性能に寄与するので、両側給電にすると１ライン毎の反射性能が平均化されて表示の均一化が図ることができるという効果もある。

【００８５】また、上記例は画素とゲート配線との重なり部分の凹凸構造の面積比を変えたが、これに限定するものではなく、ソース配線と画素の重なり部分の凹凸構造の面積比を変えても良い。また、ゲート配線とソース配線との双方の重なり部分の面積比を変えても同様の効果がある。そして、ゲート配線とソース配線との双方を変えることで、寄生容量の値をさらに任意に調整することができる。

【００８６】（実施例６）前記実施の形態６に対応する実施例であり、実施の形態６にて示した図９を用いて説明する。先ず、アレイ基板９上に、ゲート配線１、第１絶縁層１０等を形成した後、紫外線硬化型樹脂を用いてマイクロレンズ７０を作成した。次に、第２絶縁層１１を用いて全体を平坦化した後、凹凸構造５等を形成した。このとき、凹部３３の頂点７は透過部とした。マイクロレンズ７０のレンズ配置と凸部３０の配置とを重ねることで、バックライト光７１が、マイクロレンズ７０で集光されて、透過部６から出射する構成とした。このとき、マイクロレンズ７０のレンズ幅は１０μｍ、厚みは１．５μｍとした。また、凸部の幅は１２μｍとした。

【００８７】上記の如く、マイクロレンズ７０を凸部３０の下側に形成することで、バックライト光７１がマイクロレンズ７０により集光されて透過部６から出射するので（即ち、バックライト光７１が反射層３で反射される割合が低減できる）ので、輝度が向上した。そして、輝度特性について実験したところ、マイクロレンズ７０を形成した場合には、マイクロレンズ７０を形成しない場合に比べて、輝度が１２０％増加することが認められた。

【００８８】尚、第２絶縁層１１はマイクロレンズ７０上に形成するという構造に限定するものではなく、マイクロレンズ７０の下側に形成しても良い。このような構造とすれば、マイクロレンズ７０のレンズ形状を利用して、凸部３０を形成することが可能となる。第２絶縁層１１を用いると、マイクロレンズ７０の焦点距離に合わせて凸部３０の透過部６を形成でき、バックライト光の集光効率が向上する。マイクロレンズ７０の焦点距離としては、第２絶縁層１１の層厚の増加を抑制する観点から、１μｍから５μｍ程度のものを用いるのが望ましい。

【００８９】（実施例７）前記実施の形態７に対応する実施例であり、実施の形態７にて示した図１０を用いて説明する。バックライト２３からの距離に応じて、画素の透過部の面積比率を変えた。図１８に、パネル内の相対位置と透過部の面積比率及びびパネル反射率との関係を示した。パネル内の相対位置は、バックライト側が０、反対側を１と規定した。図１８に示すように、バックライトから遠ざかるに従い、面積比率を３５％（相対位置０）から５０％（相対位置１）に変化させたとき、パネル反射率は３５％から３０％に減少した。しかし、減少の程度は極めて小さく、ほぼ面内で均一な反射率であると考えられる。また、図１８には示していないが、バックライト光の透過強度も面内でほぼ均一であることが認められた。

【００９０】このように、パネルに入射する際のバックライトの強度分布に合わせて、画素の透過部の面積比率を調整することで、透過時と反射時とで、共に均一な面内輝度が実現できる。尚、前記図１２に示したように、凹凸構造の平坦な部位に透過部を設けると、透過部の面積比率を変えてもパネル反射率が変わらない領域が得られる。このため、パネル内の画素により透過部の面積比率を変えても、上記領域の範囲内での面積比率を主とし

て用いれば、透過部の面積比率をパネル内で変えてもパネル反射率をほぼ一定にすることができる。

【0091】（実施例８）前記実施の形態８に対応する実施例であり、実施の形態８にて示した図１１を用いて説明する。アレイ基板９上に凹凸構造５を幅１０μm、高さ３μmで形成した。図１９は凹凸構造５の傾斜角分布を示すグラフ。傾斜角が０°から１０°にかけて、分布はほぼ単調に増加し、１０°をピークに単調に減少した。最大の傾斜角は２０°であった。

【0092】上記のことを考慮して、アルミ合金を用いて、反射層３を凹凸構造５の傾斜角が１０°以上の領域に形成した。このとき、透過部９１と反射部９０との面積比率は、画素面積比で、透過部９１が４０％、反射部９０が６０％であった。このような構成で反射率を調べたところ、凹凸構造５における透過部９１は、反射時の集光に寄与しないため、反射率は３０％と高い値が得られた。一方、透過部９１が画素面積比で４０％あるため、透過時でも高輝度が得られた。

【0093】尚、上記例では、傾斜角が１０°以上の領域のみを透過部としたが、これに限定するものではなく、傾斜角が２°以下であるような平坦な部分も含めて透過部としても良い。このような構成であれば、平坦な部分は集光に寄与しないので、反射率の低下を防止しつつ、透過部の面積が増大するので、透過時に更なる高輝度化を図ることができる。

【0094】また、透過部の領域は傾斜角が１０°以上の領域のみに限定するものではなく、傾斜角が１２°以上、１５°以上等の領域に形成しても良い。そして、傾斜角が１２°以上の領域を透過部とすると、視認範囲が極角で－５°まで広がり、また、傾斜角が１５°以上の領域を透過部とすると、視認範囲が極角で－１０°まで広がるという効果がある。

【0095】

【発明の効果】以上、本発明によれば、反射層に透過部を有するバックライト方式の半透過型液晶パネルで反射層の比較的平坦な部分を透明とすることで、反射率を低下することなく透過率を向上することができる。また、ゲートやソース配線と画素の重なり部分の凹凸構造をゲート電位の書き込み方位に応じて変えることでフリッカー低減の効果が得られる。

【図面の簡単な説明】

【図１】図１は実施の形態１に係わる半透過型液晶表示装置のアレイ基板の上面図

【図２】図２は実施の形態１に係わる半透過型液晶表示装置のアレイ基板の断面図

【図３】図３は実施の形態２に係わる半透過型液晶表示装置のアレイ基板の上面図

【図４】図４は実施の形態２に係わる半透過型液晶表示装置のアレイ基板の断面図

【図５】図５は実施の形態２の別形態を示すアレイ基板の断面図

【図６】図６は実施の形態３に係わる半透過型液晶表示装置のアレイ基板の上面図

【図７】図７は本発明の実施の形態４に係わる半透過型液晶表示装置の構成図

【図８】図８（ａ）（ｂ）は本発明の実施の形態４に係わる半透過型液晶表示装置のアレイ基板の上面図

【図９】図９は本発明の実施の形態６に係わる半透過型液晶表示装置の断面図

【図１０】図１０は本発明の実施の形態７に係わる半透過型液晶表示装置表示の構成図

【図１１】図１１は本発明の実施の形態８に係わる半透過型液晶表示装置の構成図

【図１２】透過部の面積比率とパネル反射率との関係を示すグラフ

【図１３】図１３は実施例１に係わる半透過型液晶表示装置のアレイ基板の変形例を示す上面図

【図１４】図１４は実施例１に係わる半透過型液晶表示装置のアレイ基板の他の変形例を示す上面図

【図１５】図１５は実施例１に係わる半透過型液晶表示装置のアレイ基板の更に他の変形例を示す上面図

【図１６】図１６は実施例１に係わる半透過型液晶表示装置のアレイ基板の他の変形例を示す上面図

【図１７】図１７は実施例２に係わる半透過型液晶表示装置のアレイ基板の変形例を示す上面図

【図１８】図１８はパネル内の相対位置と透過部の面積比率及びパネル反射率との関係を示すグラフ

【図１９】図１９は凹凸構造５の傾斜角分布を示すグラフ

【図２０】図２０は従来の半透過型液晶表示装置のアレイ基板の上面図

【図２１】図２１は従来の半透過型液晶表示装置のアレイ基板の断面図

【図２２】図２２（ａ）は従来の半透過型液晶表示装置における反射層での光線軌跡を示す説明図、図２２（ｂ）は本発明の半透過型液晶表示装置における反射層での光線軌跡を示す説明図

【図２３】図２３は本発明の他の例に係る半透過型液晶表示装置における反射層での光線軌跡を示す説明図

【図２４】図２４（ａ）は反射部を観察者と反対側に広く設けたアレイ基板の上面図であり、図２４（ｂ）は反射部を観察者側に広く設けたアレイ基板の上面図である。

【符号の説明】

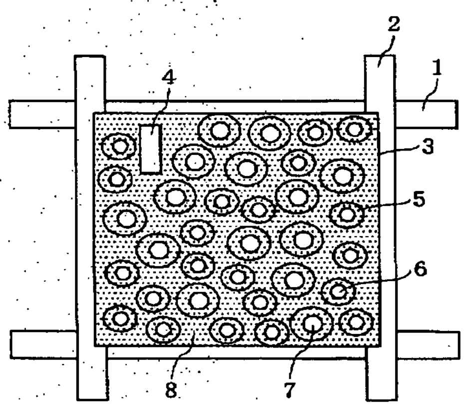
1　ゲート配線
2　ソース配線
3　反射層
4　コンタクトホール
5　凹凸構造
6　透過部

7　頂点

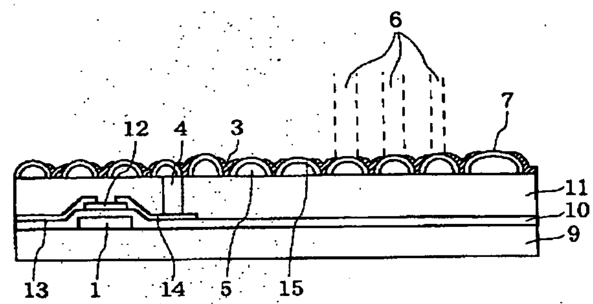
8　画素

9　アレイ基板

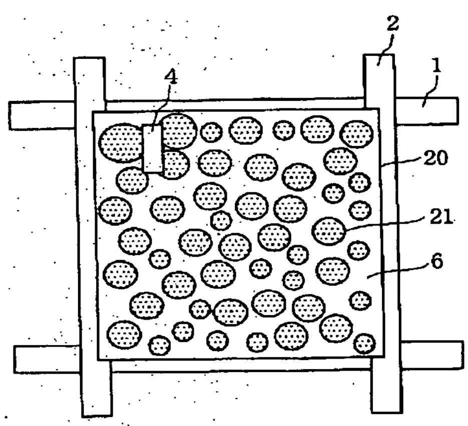
【図1】



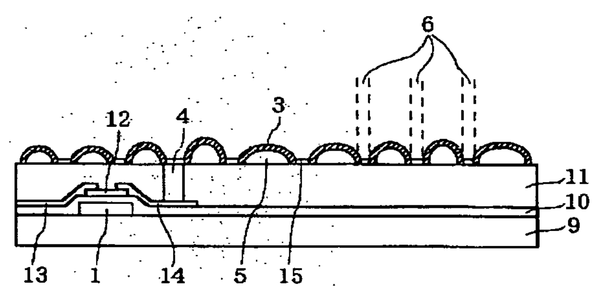
【図2】



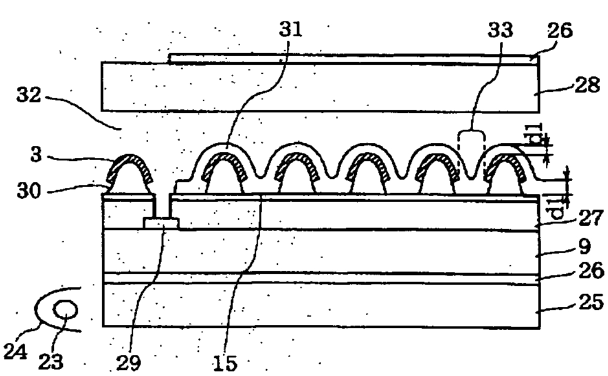
【図3】



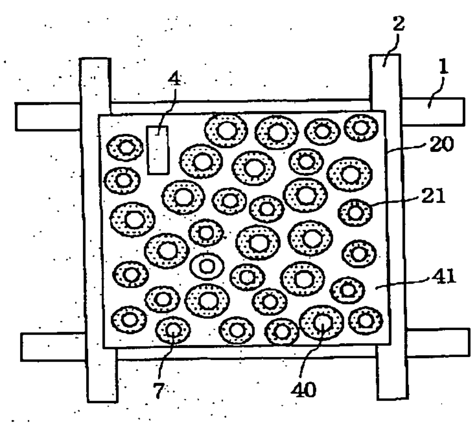
【図4】



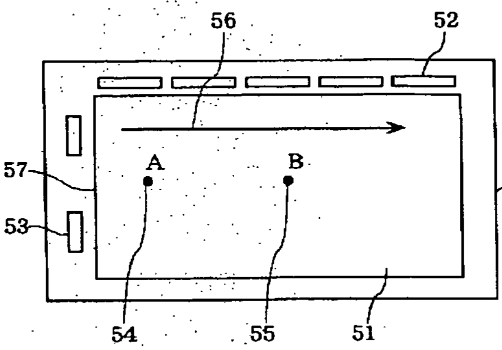
【図5】



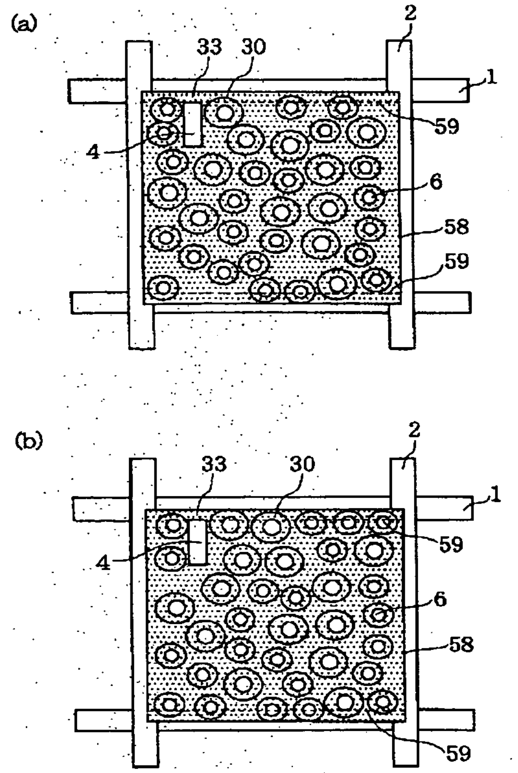
【図6】



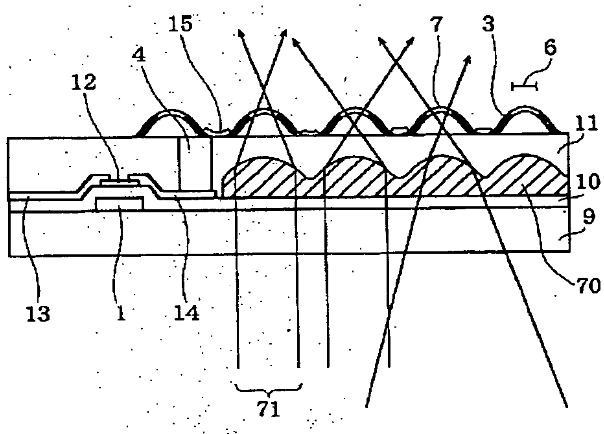
【図7】



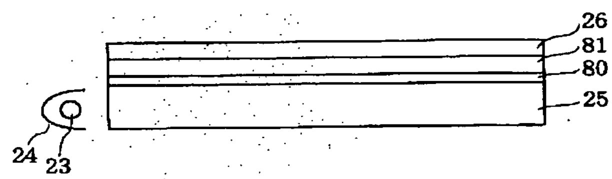
【図8】



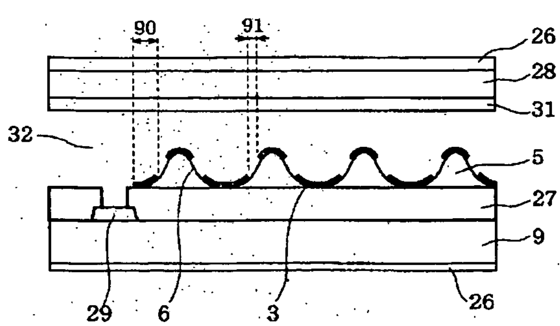
【図9】



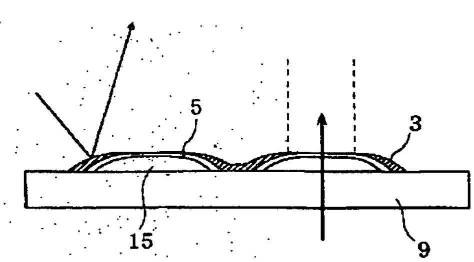
【図10】



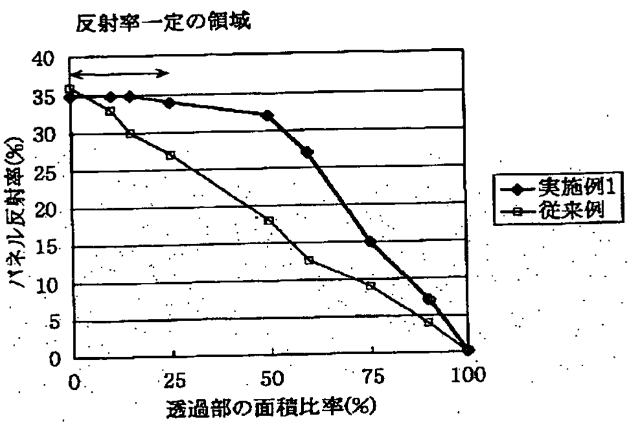
【図11】



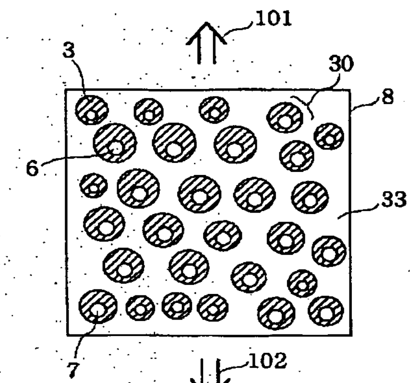
【図16】



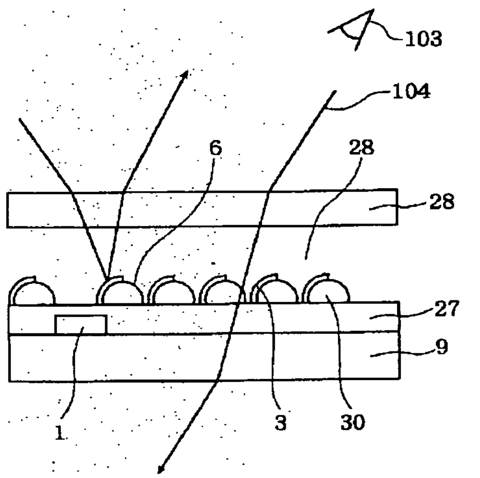
【図１２】



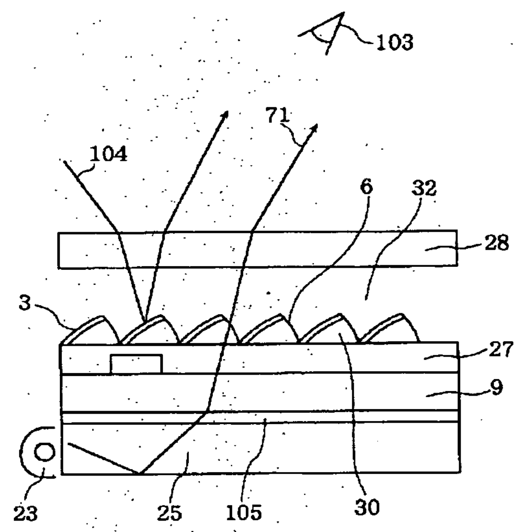
【図１３】



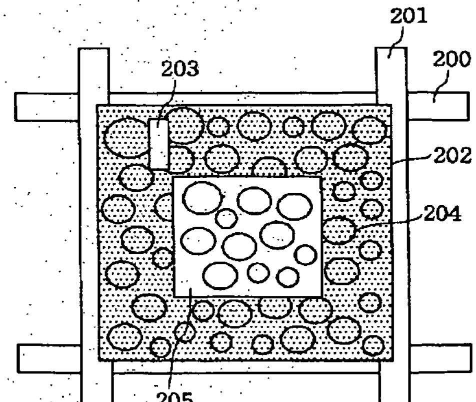
【図１４】



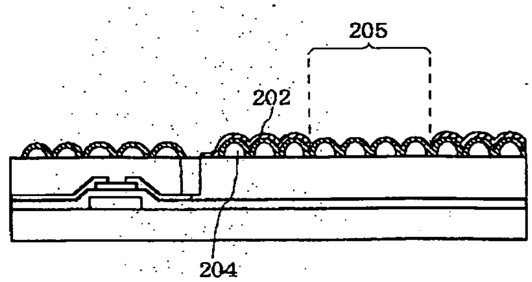
【図１５】



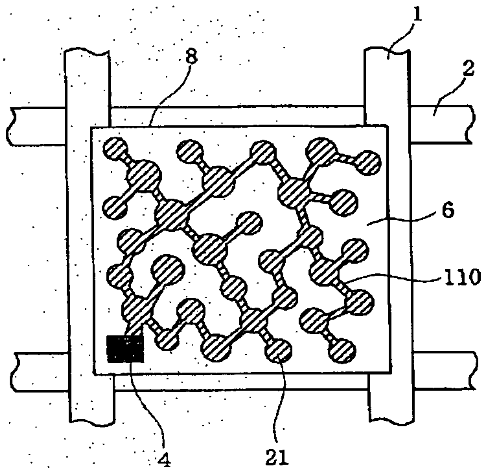
【図２０】



【図２１】



【図17】



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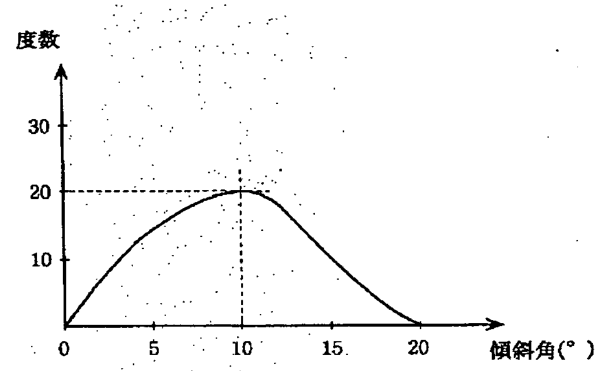
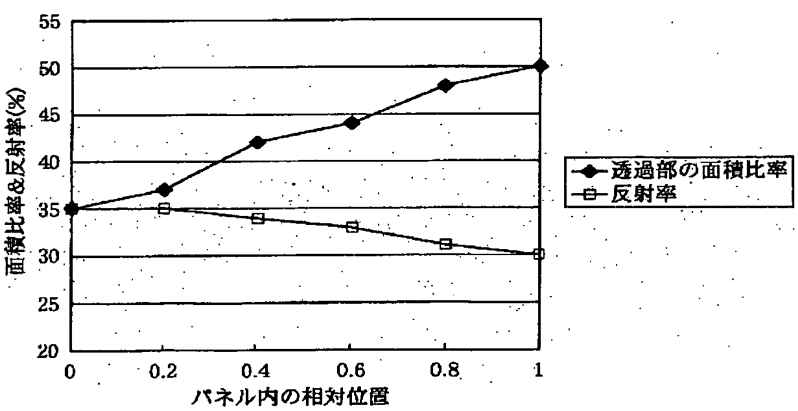
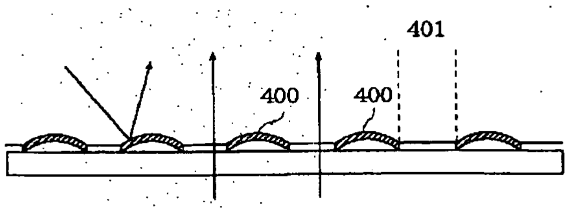


【図18】



【図23】



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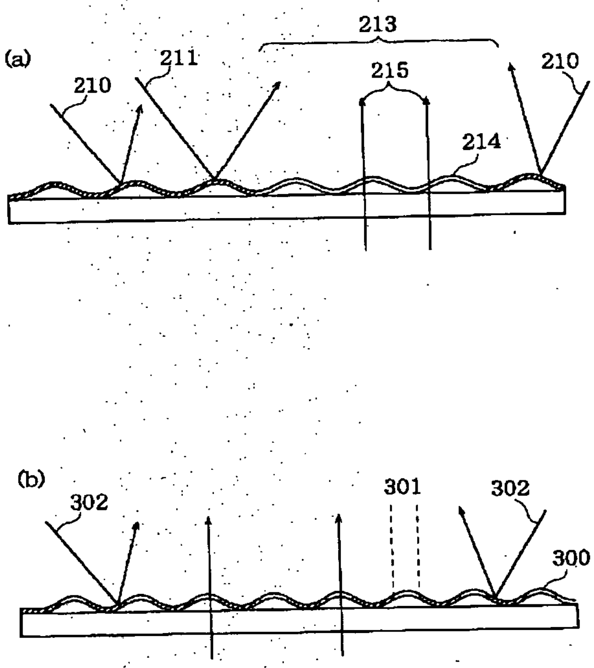
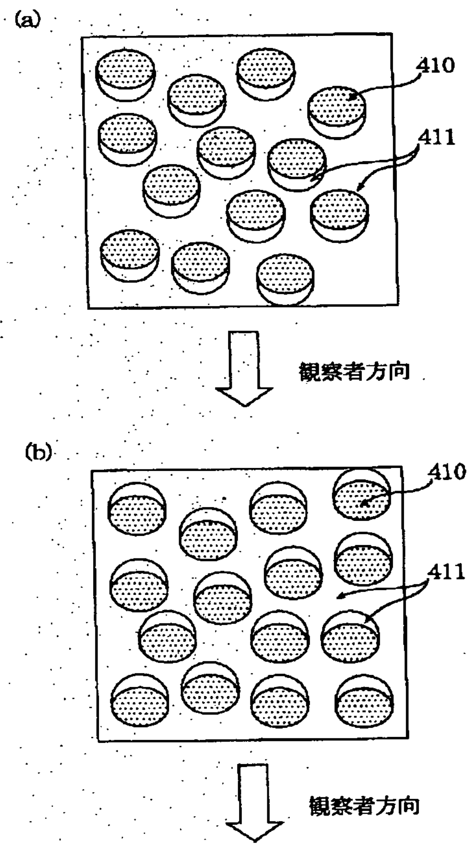


【図24】



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G 0 9 F　9/35		G 0 9 F　9/35	